

Biology - 9700

■ 26 Questions

Topics Covered :

- ✓ 1.1 - The microscope in cell studies
- ✓ 7.1 - Structure of transport tissues
- ✓ 4.2 - Movement into and out of cells
- ✓ 2.2 - Carbohydrates and lipids
- ✓ 2.3 - Proteins
- ✓ 4.1 - Fluid mosaic membranes
- ✓ 1.2 - Cells as the basic units of living organisms
- ✓ 3.2 - Factors that affect enzyme action
- + 13 more topics...

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Question No 1 - (9700_m25_22_1)

Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 1.1 - The microscope in cell studies |
(c) : 7.1 - Structure of transport tissues | (d) : 4.2 - Movement into and out of cells | (e) : 4.2 - Movement
into and out of cells | (f) :

Smilax china is a herbaceous plant.

Fig. 1.1 shows part of a transverse section of a root of *S. china* with root hair cells visible.

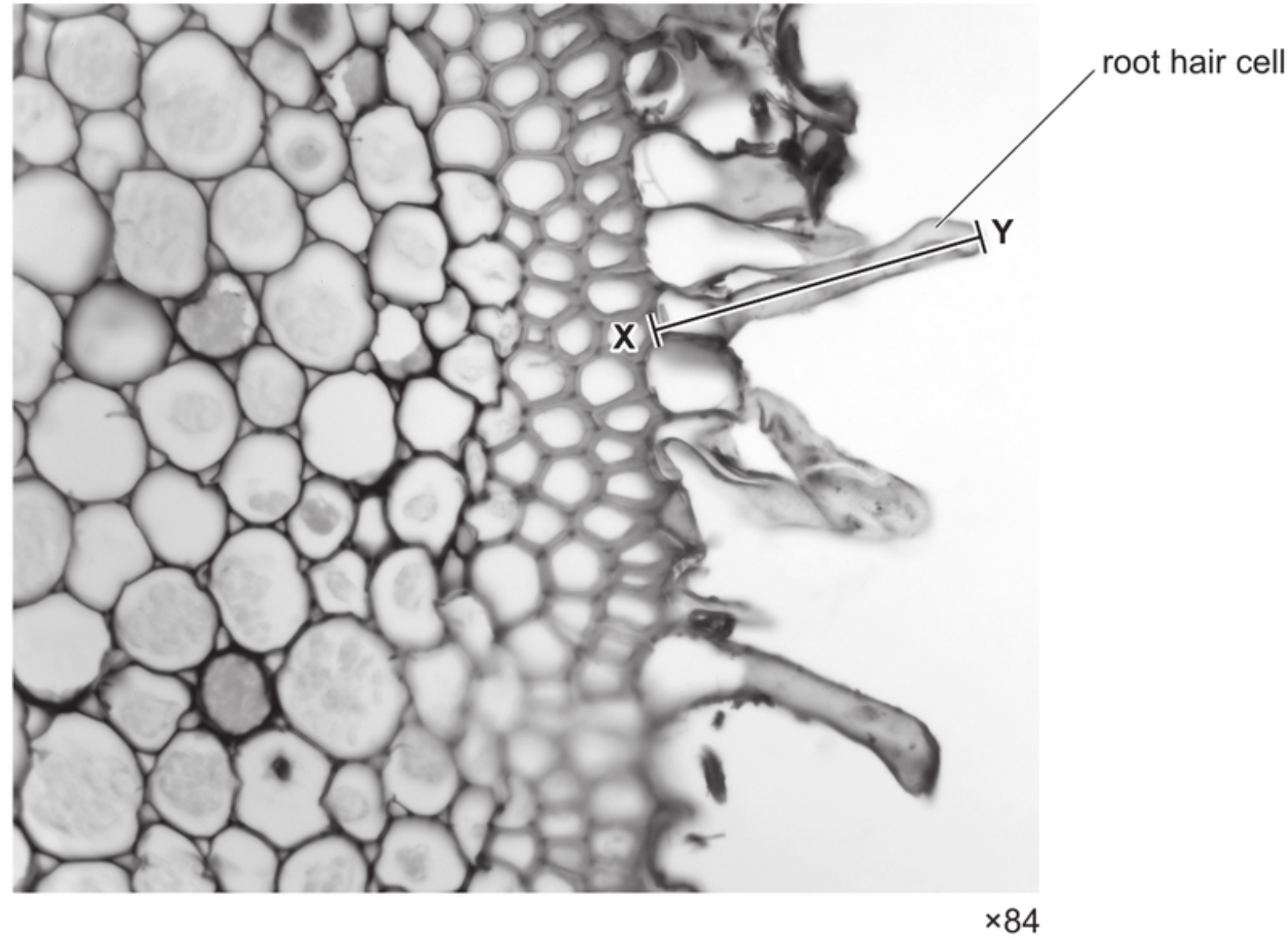


Fig. 1.1

(a) Name the type of microscope that has been used to obtain the image in Fig. 1.1.
..... [1]

(b) Calculate the **actual** length, in micrometres (μm), of the root hair cell labelled in Fig. 1.1. Use the **image** length of the root hair cell along line **X–Y** in your calculation.

actual length = μm [1]

(c) Root hairs are important adaptations of root hair cells for the uptake of water.
Explain **one** way in which root hairs adapt root hair cells for the uptake of water.
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..... [1]

(d) Mineral ions are taken up by root hair cells.

Table 1.1 shows the concentrations of sodium ions (Na^+) and potassium ions (K^+) inside the root hair cells of a plant root and in the soil solution surrounding the root.

Table 1.1

concentration of Na^+ / g dm^{-3}		concentration of K^+ / g dm^{-3}	
root hair cell	soil solution	root hair cell	soil solution
0.35	3.34	5.46	0.16

With reference to Table 1.1:

- suggest the mechanisms involved in the transport of Na^+ and K^+ from the soil solution into the root hair cells
- state the reasons for your suggestions.

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..... [3]

(e) The region between the outer layer of a root and the endodermis is known as the cortex. Table 1.2 shows the water potential of two adjacent cells, **A** and **B**, in the cortex of a root.

Table 1.2

water potential / kPa	
cortex cell A	cortex cell B
–120	–350

With reference to Table 1.2, explain the direction of water movement between cell **A** and cell **B**.

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..... [2]

(f) Some types of soil are made of small negatively charged clay particles that attract and bind to positive ions such as iron ions (Fe^{2+}).

Fe^{2+} that is bound to clay particles **cannot** be absorbed by root hair cells. This reduces the concentration of free Fe^{2+} that is available in soil solution for absorption.

Some plants that grow in soils containing a high proportion of clay particles are able to increase the concentration of free Fe^{2+} in the soil solution for absorption. In these plants, the carbon dioxide released by the respiration of root hair cells reacts with water in the soil solution, which changes the pH of the soil solution. This affects the binding of positively charged ions, such as Fe^{2+} , to clay particles.

Fig. 1.2 shows the results of one investigation into the effect of pH on the concentration of free Fe^{2+} that is available in soil solution for absorption by root hair cells. The soil sample analysed in this investigation was from a soil that contained a high proportion of clay particles.

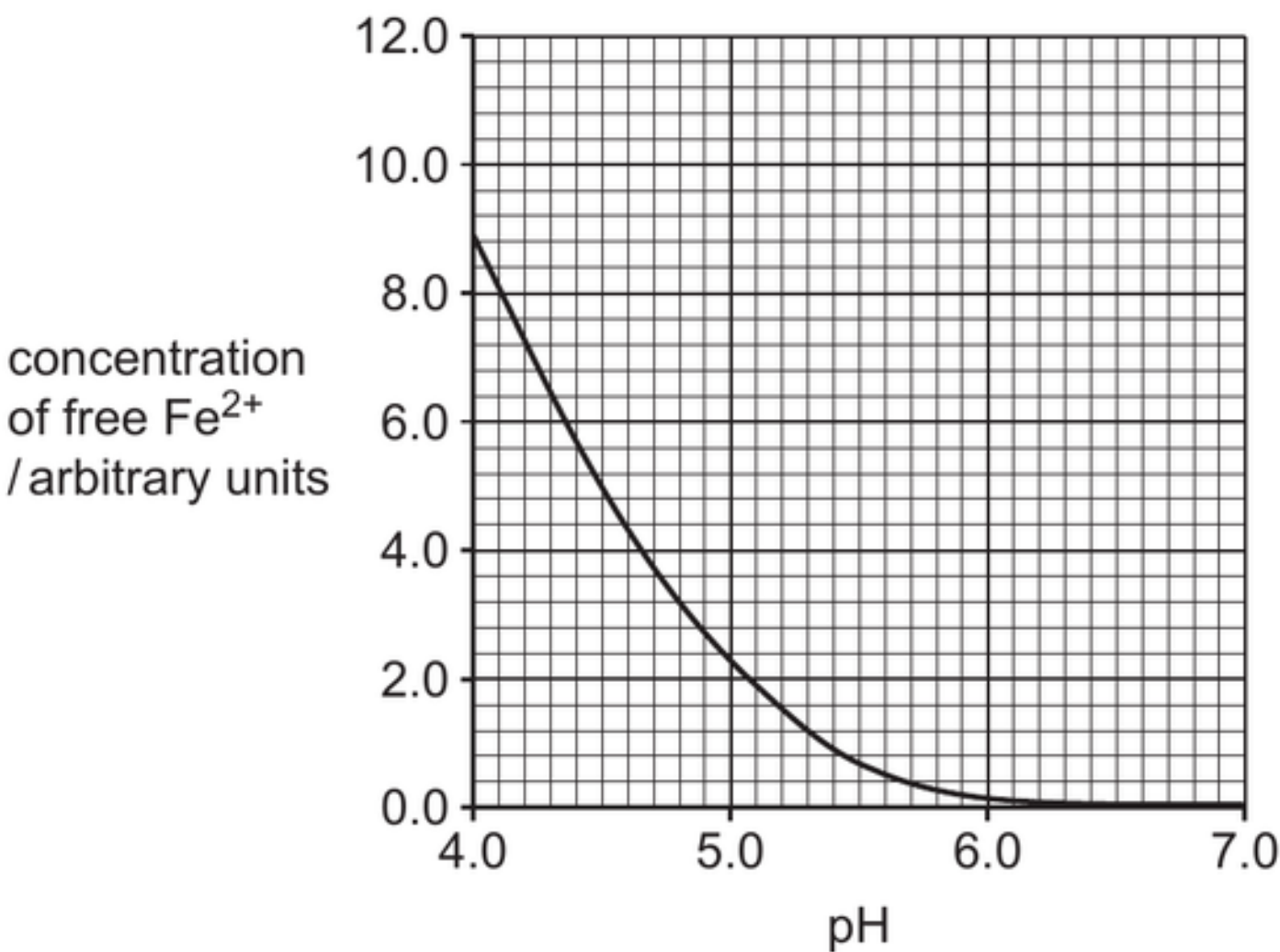


Fig. 1.2

- (i) With reference to Fig. 1.2, suggest **and** explain how the carbon dioxide released by the respiration of root hair cells can increase the concentration of free Fe^{2+} for absorption by root hair cells.

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- (ii) Dissolved Fe^{2+} is transported across the tissues of the root to the xylem.

When the amount of dissolved Fe^{2+} absorbed by root hair cells is greater than the amount that is needed by the plant, not all of the Fe^{2+} that is absorbed is transported to the xylem.

Suggest how the endodermis can reduce the amount of Fe^{2+} reaching the xylem.

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[3]

Table 2.1 shows the R-groups of cysteine and serine.

Table 2.1

amino acid	R-group	feature of R-group
cysteine (Cys)	—CH ₂ SH	can form a disulfide bond
serine (Ser)	—CH ₂ OH	hydroxyl group present



Compared to other protein molecules with a similar number of amino acids, β-casein molecules have:

- a much less organised secondary structure
- relatively little tertiary structure.

With reference to the four named amino acids, proline, leucine, serine and cysteine, suggest possible explanations for these **two** observations.

less organised secondary structure

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relatively little tertiary structure

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[4]

Question No 3 - (9700_m24_22_1)

Subsection Topics: (a) : 2.2 - Carbohydrates and lipids, 4.1 - Fluid mosaic membranes | (b) : 4.2 - Movement into and out of cells | (c) : 1.2 - Cells as the basic units of living organisms, 2.3 - Proteins, 3.2 - Factors that affect enzyme action

(a) Fig. 1.1 is a diagram representing part of the phospholipid bilayer of a cell surface membrane.

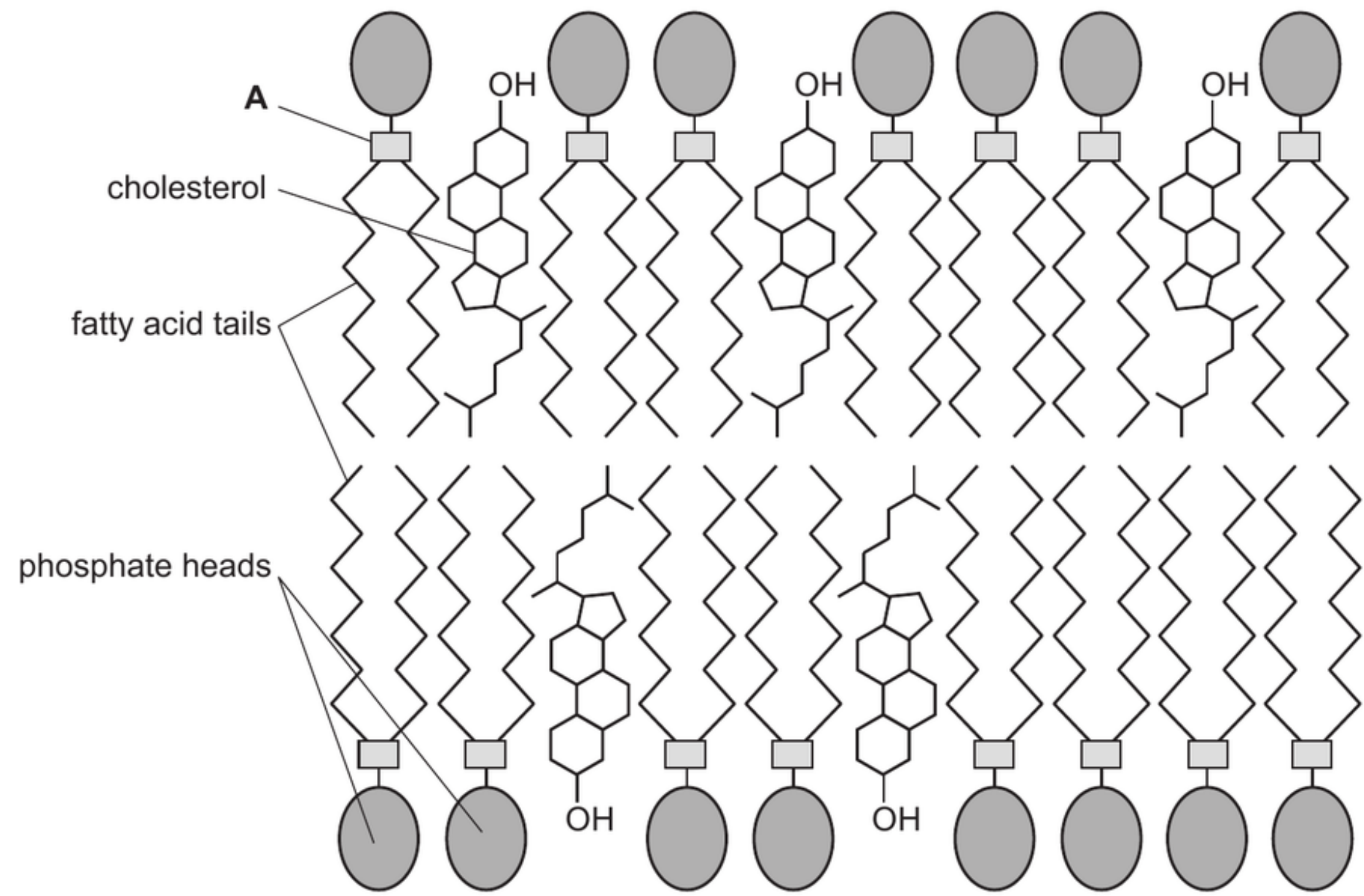


Fig. 1.1

(i) Identify the part of a phospholipid molecule, labelled **A** in Fig. 1.1, that forms bonds with the phosphate heads and with the fatty acid tails.

..... [1]

(ii) Cholesterol is an important lipid component of many cell surface membranes. Fig. 1.2 shows the structure of a cholesterol molecule.

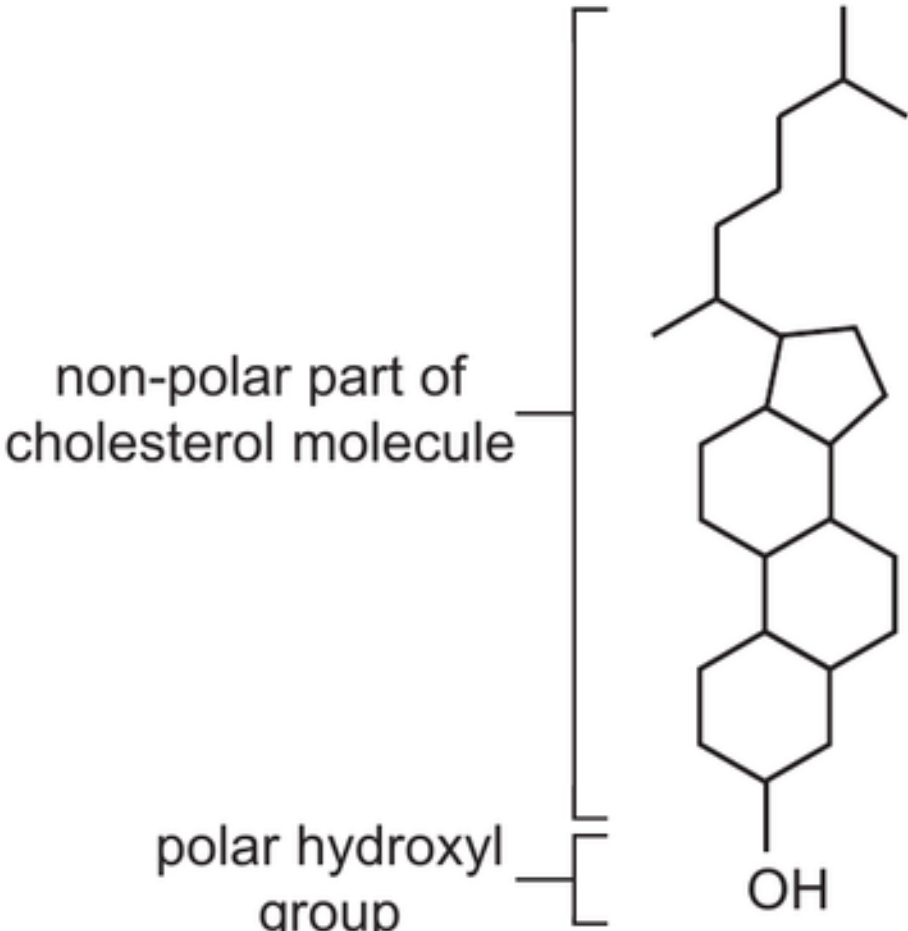


Fig. 1.2

Using the information in Fig. 1.2, explain the orientation (positioning) of cholesterol molecules in the phospholipid bilayer, as shown in Fig. 1.1.

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.....
..... [1]

(iii) State **one** role of cholesterol in phospholipid bilayers.

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..... [1]

(b) (i) Explain why sodium ions **cannot** cross phospholipid bilayers by simple diffusion.

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.....
..... [1]

(ii) Ions and some molecules move across cell surface membranes by facilitated diffusion and active transport.

Compare facilitated diffusion and active transport by stating **one** way in which they are similar and **two** ways in which facilitated diffusion is different from active transport.

similarity

.....

difference 1

.....

.....

difference 2

.....

.....

[3]

(c) Prostaglandins are small lipids produced in many tissues of the body. One role of prostaglandins is to cause inflammation at the site of an injury or infection. Inflammation is the normal first

response of the immune system to injury or infection.

Cyclooxygenase (COX) is an enzyme that catalyses one of the steps in the reaction pathway for the formation of prostaglandins from phospholipids. The reaction pathway occurs in the smooth endoplasmic reticulum (SER) of cells. Part of the reaction pathway is shown in Fig. 1.3.

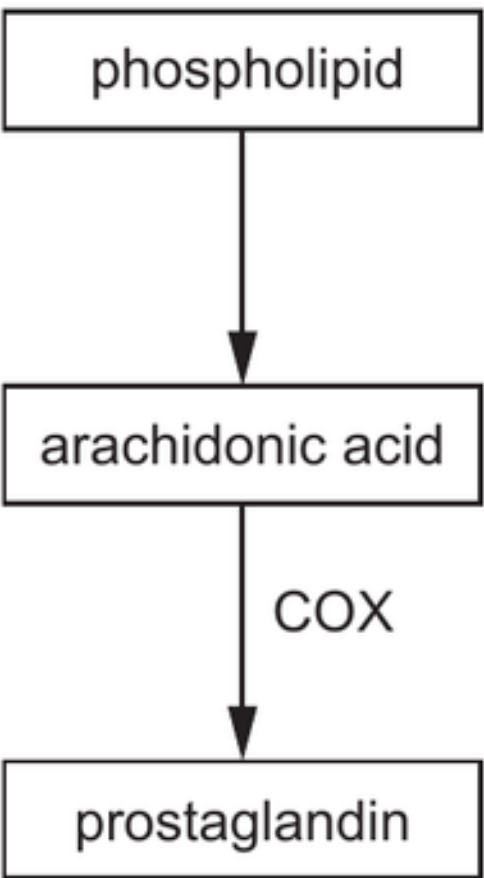


Fig. 1.3

- (i) Suggest an advantage for this reaction pathway occurring in the smooth endoplasmic reticulum of a cell rather than in the cytoplasm.

.....

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..... [1]

- (ii) Sometimes inflammation can have side-effects, such as pain. Aspirin is a drug that can be used to reduce these side-effects.

Aspirin reduces the catalytic activity of the COX enzyme by modifying the R-group of one of the amino acids.

Suggest how modifying the R-group of an amino acid in the COX enzyme can reduce the catalytic activity of the enzyme.

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..... [3]

- (iii) Prostaglandins are examples of cell-signalling molecules.

Outline the process of cell signalling that leads to a response by the cells involved in inflammation.

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..... [2]

Question No 4 - (9700_s24_21_1)

Subsection Topics: (a) : 4.1 - Fluid mosaic membranes | (b) : 1.1 - The microscope in cell studies, 1.2 - Cells as the basic units of living organisms

Fig. 1.1 is a diagram showing part of a cell surface membrane of an animal cell.

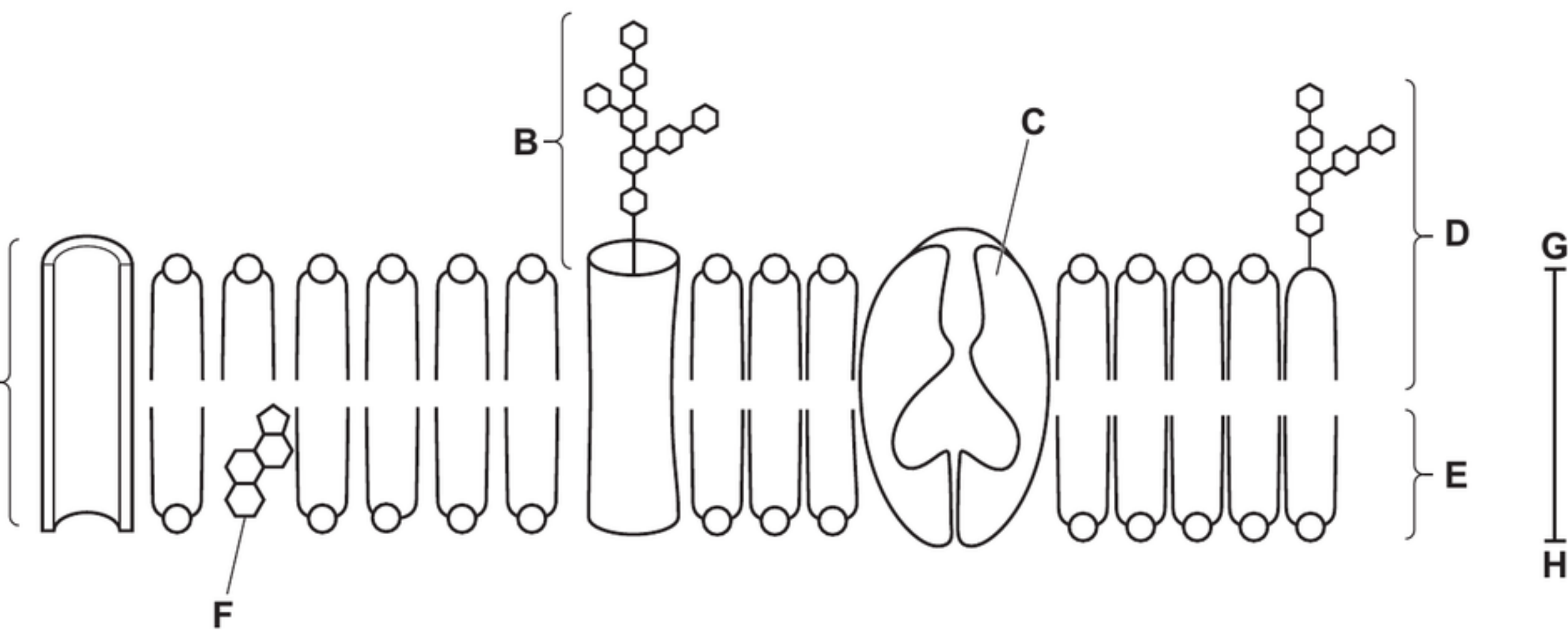


Fig. 1.1

- (a) (i) State the approximate thickness of the membrane as shown by the line **G–H**.
- [1]
- (ii) Complete Table 1.1 to show:
- the names and functions of the components of the cell surface membrane
 - the letters of the labels in Fig. 1.1 that identify each component.

Table 1.1

component	function	letter on Fig. 1.1
channel protein		
phospholipid		
	receptor for cell signalling	
		F

[4]

- (b) Fig. 1.2 is a drawing of a transmission electron micrograph (TEM) of a cell from the palisade mesophyll of a leaf.

The drawing does **not** show all of the organelles visible in a transmission electron micrograph.

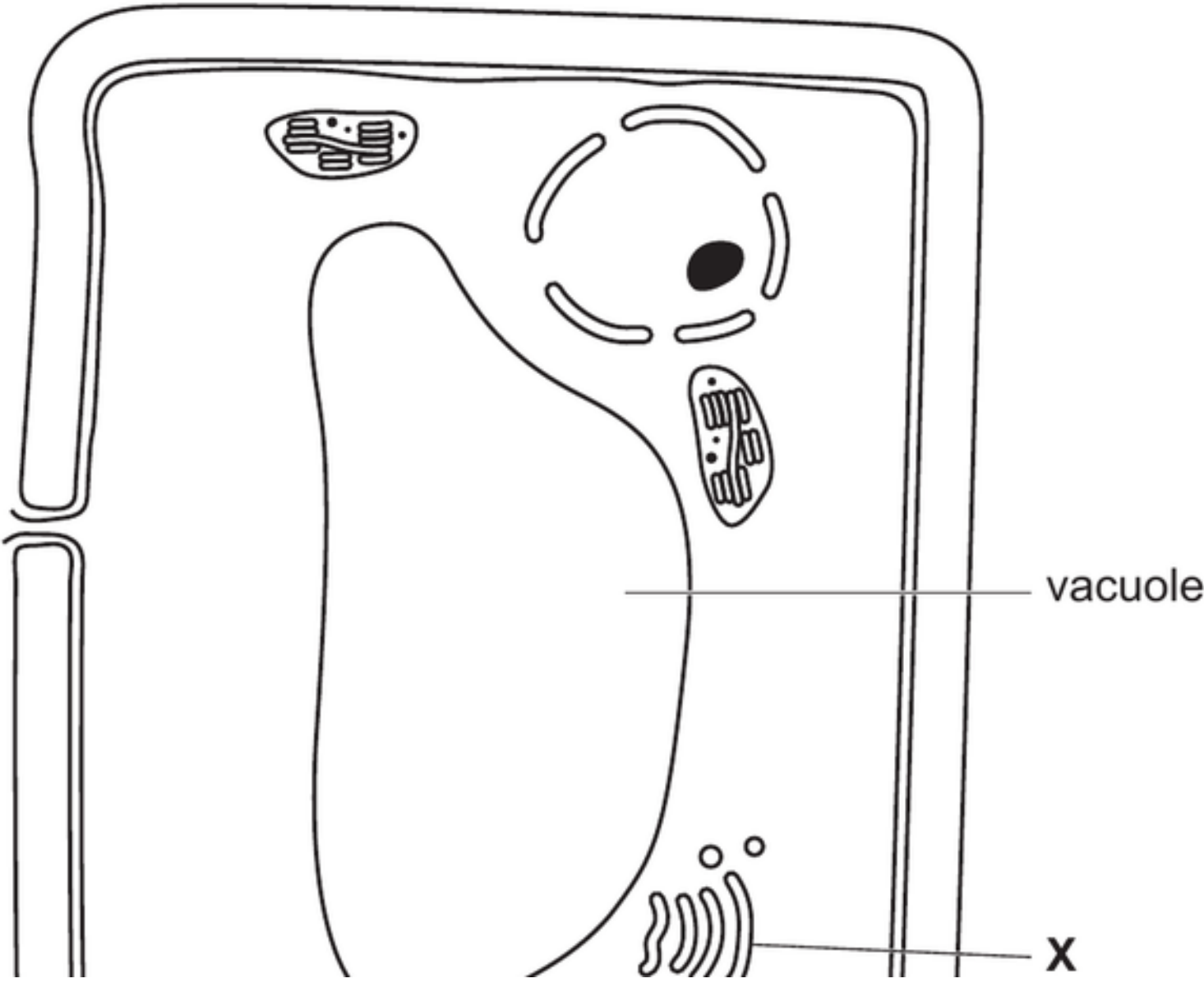




Fig. 1.2

(i) Complete Fig. 1.2 by drawing **and** labelling:

- a mitochondrion
- rough endoplasmic reticulum
- smooth endoplasmic reticulum.

Your drawings should show the detail that can be seen in a transmission electron micrograph. [3]

(ii) Identify the organelle labelled **X** and state **one** function of this organelle.

name

function

.....

[2]

[Total: 10]

Question No 5 - (9700_s24_22_2)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms, 1.1 - The microscope in cell studies | (b) : 4.2 - Movement into and out of cells | (c) : 11.2 - Antibodies and vaccination

Alveolar macrophages are cells of the immune system that remain in the alveolar region of the gas exchange system. The macrophages protect against infection caused by pathogens that have been inhaled.

- (a) Alveolar macrophages have the same cell structures as typical animal cells.
- (i) Complete Table 2.1 to **name** the cell structures that match the functions stated.
- Do **not** use abbreviations.

Table 2.1

cell structure	function
.....	manufactures ribosomal subunits from proteins and ribosomal RNA
.....	synthesises triglycerides and other lipids
pair of	organise microtubules of the cell cytoskeleton

[3]

- (ii) Fig. 2.1 is a diagram of an alveolar macrophage showing:
- some of the cell structures that would be visible using an electron microscope
 - a newly formed phagocytic vacuole (phagosome) containing two cells of *Mycobacterium tuberculosis*.

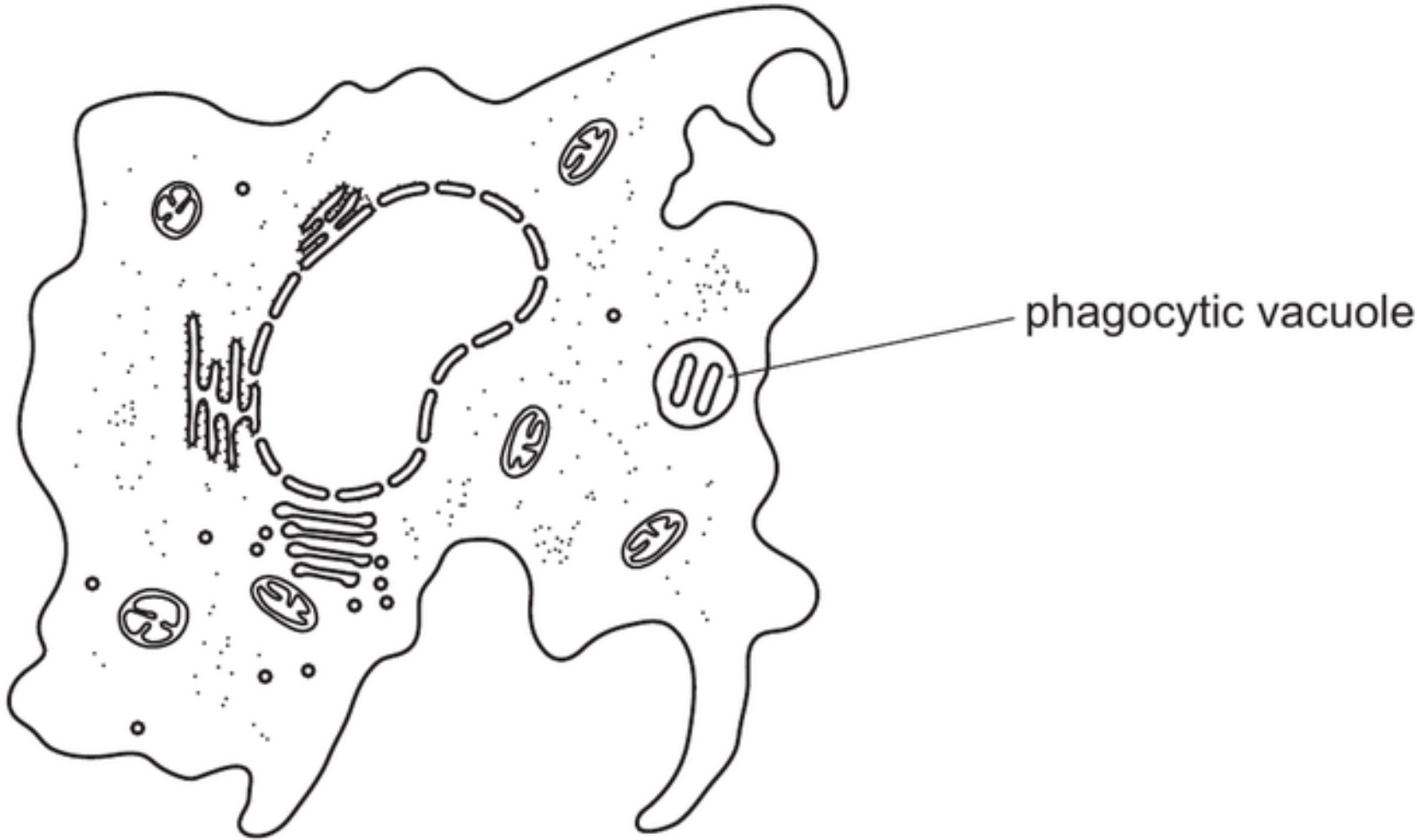


Fig. 2.1

The cell structures with the functions described in Table 2.1 are **not** shown in Fig. 2.1.

Complete Fig. 2.1 by drawing **and** labelling the cell structures described in Table 2.1. [2]



- (b) Tuberculosis (TB) can be prevented if the bacterial cells that have reached the alveoli are rapidly destroyed. Alveolar macrophages can detect the presence of *M. tuberculosis* in the alveolar space and can carry out phagocytosis to form phagocytic vacuoles, such as the one shown in Fig. 2.1.
- (i) Outline the sequence of events that leads to the formation of a phagocytic vacuole after detection of the bacterial cells by an alveolar macrophage.
-
-
-
-
- [2]
- (ii) Name the cell structures that fuse with the phagocytic vacuole and release hydrolytic enzymes to destroy the bacterial cells.
- [1]
- (c) Research has shown that vaccination programmes are cost effective and are very helpful

in the prevention and control of TB. The programmes may be aimed at particular groups of people that are at a high risk of getting the disease, or they may be aimed at an entire population because the country has a high number of cases of TB.

The Bacillus Calmette-Guérin (BCG) vaccine is freeze-dried and contains live, weakened (attenuated) *Mycobacterium bovis*.

Apart from being cost effective, suggest **and** explain the advantages of using the BCG vaccine for the prevention and control of TB.

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..... [4]

[Total: 12]

Question No 6 - (9700 s24 22 4)

Subsection Topics: (c) : 4.2 - Movement into and out of cells | (e) : 7.2 - Transport mechanisms | (a) : 2.2 - Carbohydrates and lipids | (b) : 6.2 - Protein synthesis | (d) : 7.2 - Transport mechanisms

In the mesophyll tissue of leaves, products of photosynthesis can be used to synthesise organic compounds, such as the polysaccharide cellulose and some amino acids.

A source of nitrogen for amino acid synthesis can be provided by nitrate ions that have been taken up in the roots and transported to the leaves.

(a) Describe the structure of a cellulose molecule

..... [3]

who

(b) Studies of nitrate uptake and nitrate metabolism help to provide information to scientists who are investigating ways to increase the yield of crop plants.

The first step of nitrate metabolism in leaf cells is the reduction of nitrate to nitrite, catalysed by the enzyme nitrate reductase. The activity of the enzyme can be studied by detecting the

(i) Researchers have found that adding nitrate to leaf tissue results in an increase in

State **one** benefit to leaf cells of an increase in mRNA molecules of gene *NR* after the

.....



(ii) One method used to detect the presence of nitrite formed from the reduction of nitrate in

- using an inhibitor to prevent nitrite from taking part in further reactions in the leaf tissue

- immersing the leaf tissue in a solution containing a colourless test reagent.

solution to magenta (red-purple).

nitrite.

(c) In the leaf, transport of amino acids from mesophyll cells to companion cells involves using a

There is evidence that amino acids can move from the apoplast into the cytoplasm of a

companion cell using the same transport mechanism that is used for sucrose transport.

transported from the apoplast into the cytoplasm of a companion cell.

..... [4]

(ii) Suggest why amino acid transporters are **not** needed to move amino acids from the companion cell into a phloem sieve tube element.



To investigate nitrate uptake, roots can be cut and removed (excised) and placed in a buffered

solution containing nitrate ions. The root tissue can be analysed to determine the quantity of nitrate taken up over a set time period.

(d) Excised roots of the crop plant maize, *Zea mays*, were placed in three different concentrations of nitrate solution: 0.2 mmol dm^{-3} , 1.0 mmol dm^{-3} and 5.0 mmol dm^{-3} .

The solutions were maintained at 30°C and were aerated to provide a continuous supply of oxygen to the root tissue.

Nitrate (NO_3^-) uptake by the root

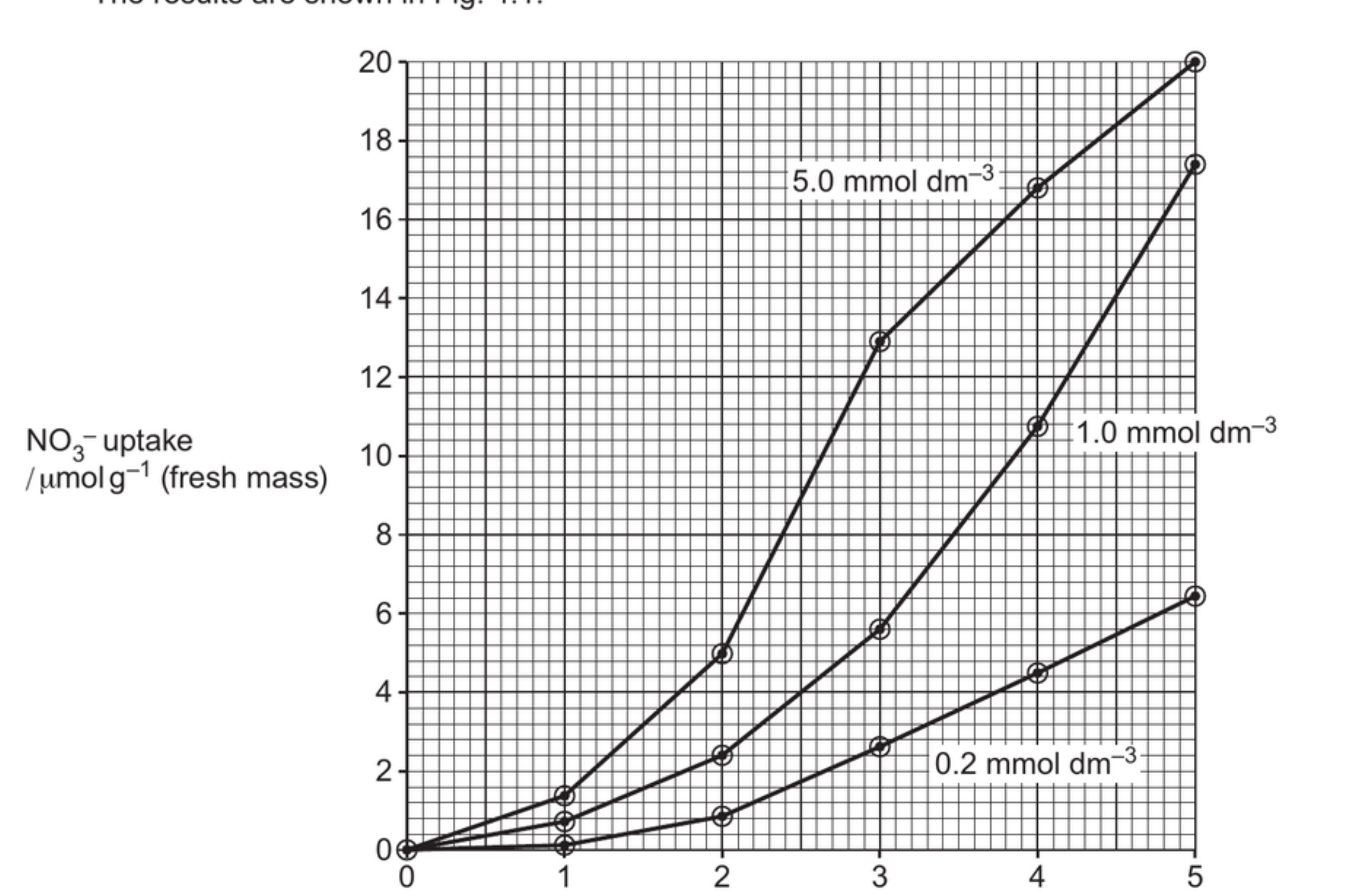


Fig. 4.1



Describe the differences in the rates of nitrate uptake for 0.6mmol dm⁻³ nitrate solution compared with 0.2mmol dm⁻³ nitrate solution, between 2h and 5h

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[21]



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- how nitrate ions are taken up by the root cells
- the factors affecting the uptake of nitrate ions.

[4]

Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 4.2 - Movement into and out of cells

- (a) Describe the transport of water from the soil solution to the endodermis of roots by the **apoplast** pathway **and** explain why this pathway cannot continue at the endodermis.

[4]

- Complete Table 6.1 to provide information about the two different transport mechanisms that were identified by the researchers.

Table 6.1

net movement of K^+	membrane protein needed (yes or no)	ATP used (yes or no)	name of transport mechanism
against the concentration gradient			
down the concentration gradient			

[Total: 7]

Question No 8 - (9700_w24_22_1)

Subsection Topics: (a) : 2.2 - Carbohydrates and lipids | (b) : 2.4 - Water | (c) : 7.1 - Structure of transport tissues

The olive plant, *Olea europaea*, is grown in many parts of the world. The fruits of the plant (olives) and the oil that can be obtained from the fruits (olive oil), provide food for humans.

Triglycerides are the main type of lipid in olive oil. They are synthesised in the olive plant from glycerol and fatty acids.

Scientists can analyse samples of different olive oils to identify:

- the fatty acids used to synthesise triglycerides
- the composition of the different triglycerides present.

(a) Table 1.1 shows some details of the five most common fatty acids found in samples of olive oil produced by olive plants grown in different regions in Portugal.

Table 1.1

Key

C : D = number of carbon atoms : number of double bonds in the hydrocarbon chain

X = missing detail

fatty acid	percentage of total fatty acid content	C : D	chemical structure
oleic acid	55.0–83.0	18 : 1	CH ₃ (CH ₂) ₇ CH=CH(CH ₂) ₇ X
palmitic acid	7.5–20.0	16 :	CH ₃ (CH ₂) ₁₄ X
linoleic acid	3.5–21.0	18 :	CH ₃ (CH ₂) ₄ (CH=CH)CH ₂ (CH=CH)(CH ₂) ₇ X
stearic acid	0.5–5.0	18 :	CH ₃ (CH ₂) ₁₆ X
palmitoleic acid	0.3–3.5	16 :	CH ₃ (CH ₂) ₅ CH=CH(CH ₂) ₇ X

- (i) Table 1.1 shows the **C : D** values for oleic acid.
- In Table 1.1, write the values for **D** for each of the four other fatty acids listed. [1]
- (ii) In the first column of Table 1.1, draw a circle around each of the fatty acids that can be described as saturated. [1]
- (iii) State the detail of chemical structure, represented by **X**, which is missing from Table 1.1.
- [1]



- (iv) The analysis of the triglycerides present in the different samples of olive oil showed that:
- there are many different triglycerides present in olive oil
 - each olive oil is different in its composition, but the same few triglycerides are present in all olive oils.
- With reference to Table 1.1 and to the structure of triglycerides, suggest explanations for these observations.
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-
-
-
- [2]

(b) Glycerol is soluble in water. Triglycerides are insoluble in water.

Explain why water is a good solvent for some substances such as glycerol, but is a poor solvent for substances such as triglycerides.

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solvent for substances such as triglycerides.

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..... [2]

- (c) Phloem is the plant tissue responsible for the transport of organic substances, such as fatty acids, from one area of a plant to another. The tissue is composed of more than one type of cell.

Name the type of cell that forms the transport vessels of phloem tissue.

..... [1]

[Total: 8]

Question No 9 - (9700_m23_22_1)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 4.1 - Fluid mosaic membranes | (c) : 5.1 - Replication and division of nuclei and cells

- (a)** Table 1.1 lists cell structures that can be found in eukaryotic cells or prokaryotic cells. Some of these cell structures can be found in both types of cell.

Complete the table using a tick (✓) to show that the cell structure can be present in a particular type of cell and a cross (✗) to show that the cell structure **cannot** be present.

Put a tick or a cross in every box.

The top row has been completed for you.

Table 1.1

cell structure	eukaryotic cells	prokaryotic cells
nucleus	✓	✗
Golgi body		
circular DNA		
70S ribosome		

[2]

- (b)** All cells have a cell surface membrane. Fig. 1.1 shows a transmission electron micrograph of part of **two** adjacent animal cells, cell 1 and cell 2.

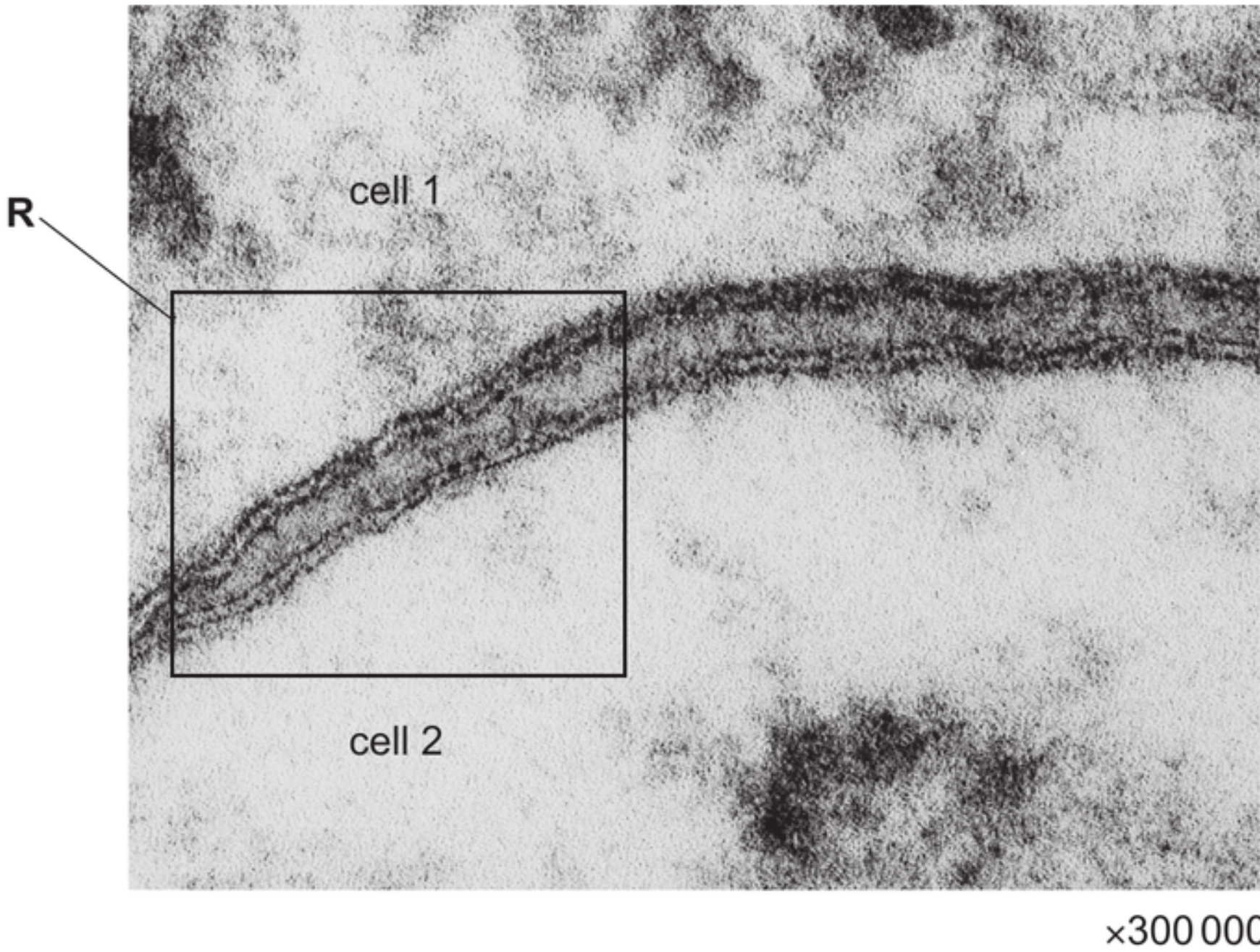


Fig. 1.1

In the space provided, draw a diagram of the region in the box labelled **R** on Fig. 1.1. Your diagram should show the four dark lines.

Label the diagram to identify what is shown by the dark lines and each of the three spaces between them.

space for diagram:

(c) Mitogens are short chains of amino acids that function as cell-signalling molecules. Mitogens are released from secretory cells and travel in the blood to target cells, where the mitogens bind to cell surface receptors. The target cells respond by progressing from the G_1 phase to the S phase of the mitotic cell cycle.

(i) Outline what happens in the G_1 phase and S phase of the mitotic cell cycle.

G_1 phase

.....

.....

S phase

.....

.....

[2]

(ii) As a result of mutation, the production and release of mitogens into the blood can be greatly increased.

Suggest a possible consequence for target cells of increased concentrations of mitogens in the blood.

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..... [1]

[Total: 8]

Question No 10 - (9700_s23_21_3)
Subsection Topics: (a) : 4.2 - Movement into and out of cells | (b) : 4.2 - Movement into and out of cells |
(c) : 11.1 - The immune system

Fig. 3.1 shows some fruits (grapes) of the grapevine, *Vitis vinifera*.



Fig. 3.1

Sucrose is transported in the phloem of the grapevine to the fruits. In the fruits, sucrose is hydrolysed by the enzyme sucrase, which is found in cell walls. The glucose and fructose produced by the hydrolysis of sucrose pass through membrane proteins, known as hexose transporters, into the cytoplasm of the fruit cells.

(a) State why membrane proteins are required for the movement of molecules, such as glucose, across cell surface membranes into cells.

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..... [1]

Researchers investigated one type of hexose transporter, known as VvHT1, which is found in the fruit cells of *V. vinifera*. They used a mutant strain of yeast that has very few hexose transporters in its cell surface membranes to investigate the properties of VvHT1. The researchers inserted molecules of VvHT1 into the cell surface membranes of the mutant strain of yeast.

- Equal volumes of mutant yeast cells with VvHT1 were kept in eight different concentrations of glucose solution.
- The rate of uptake of glucose by the yeast cells in each solution was determined.
- All the solutions were kept at the same temperature and pH.

The results are shown in Fig. 3.2.

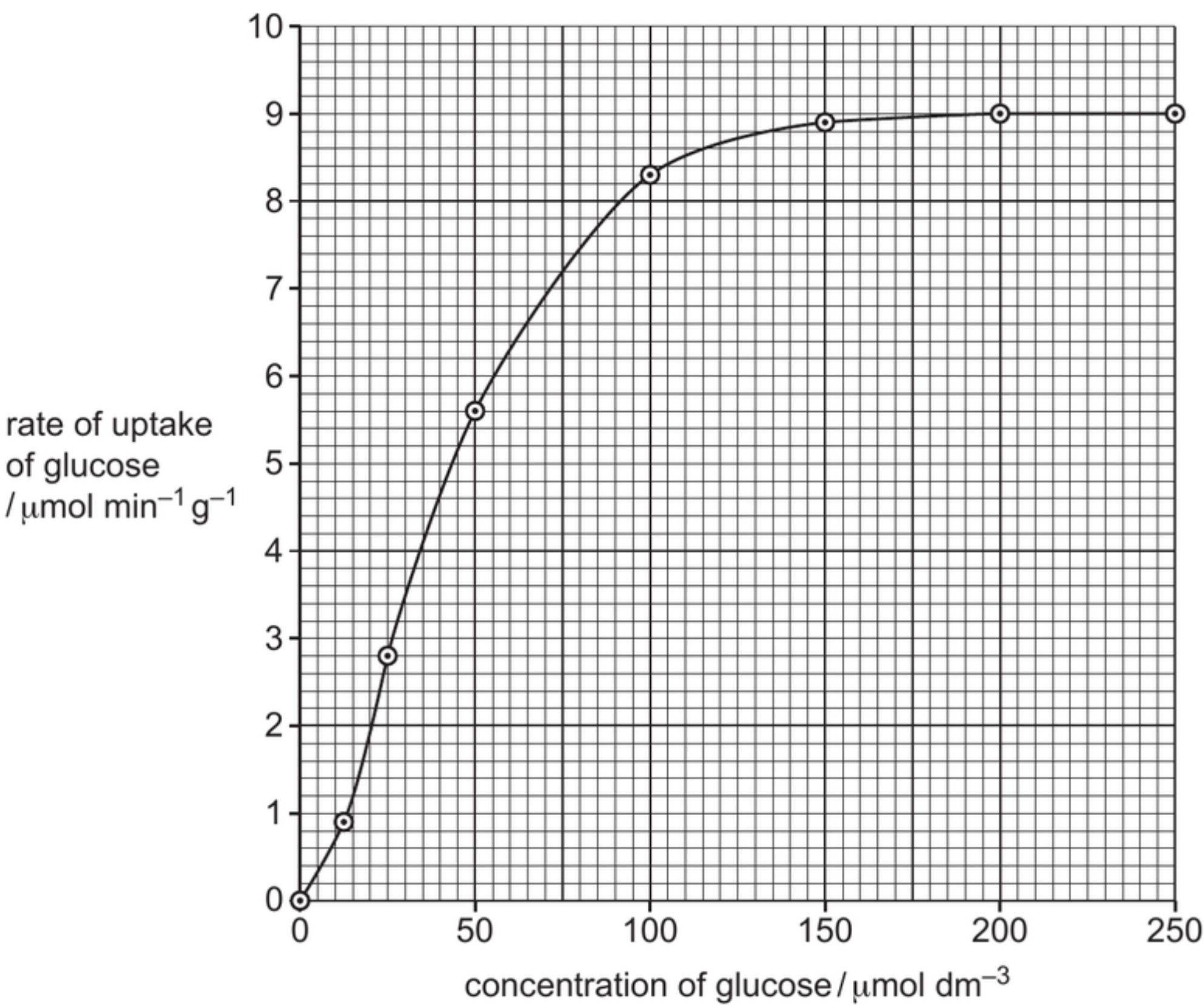


Fig. 3.2

(b) (i) The researchers concluded that VvHT1 is responsible for the facilitated diffusion of glucose into the cells.

Explain how the results in Fig. 3.2 provide evidence to support this conclusion.

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..... [2]

(ii) The researchers thought that grapevines could be modified to have more hexose transporters to increase the size and quality of grapes.

Explain why increasing the number of hexose transporters could be commercially important to growers of grapevines.

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..... [2]

(c) Fig. 3.3 is a diagram of a protein in the cell surface membrane of a macrophage from a

mouse.

Macrophages use these proteins in antigen presentation. Non-self antigens bind to the proteins and are involved in the activation of specific T-lymphocytes during the immune response.

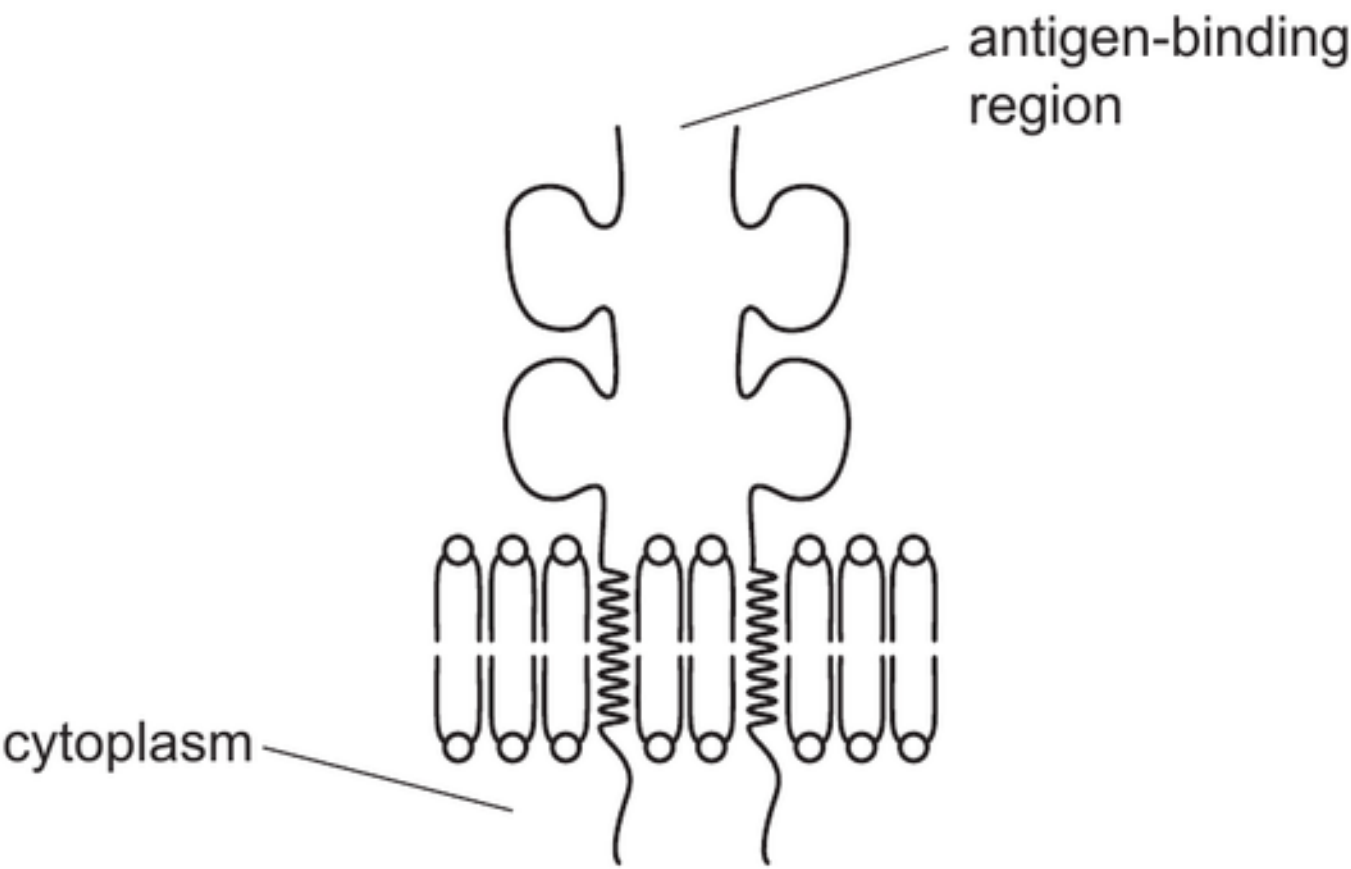


Fig. 3.3

(i) State what is meant by a non-self antigen.

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..... [1]

(ii) Some pathogens enter human cells. Macrophages partially digest these pathogens and present antigens to T-lymphocytes during immune responses.

With reference to Fig. 3.3, explain how T-lymphocytes respond to infection by a specific type of pathogen.

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..... [4]

Question No 11 - (9700_s23_23_6)

Subsection Topics: (a) : 2.2 - Carbohydrates and lipids | (b) : 4.1 - Fluid mosaic membranes | (c) : 4.1 - Fluid mosaic membranes

Polysaccharides, such as glycogen, are composed of thousands of monomers.

Oligosaccharides are carbohydrates that contain three to ten monomers in their chain.

(a) Nystose is one example of an oligosaccharide. The structure of nystose is shown in Fig. 6.1.

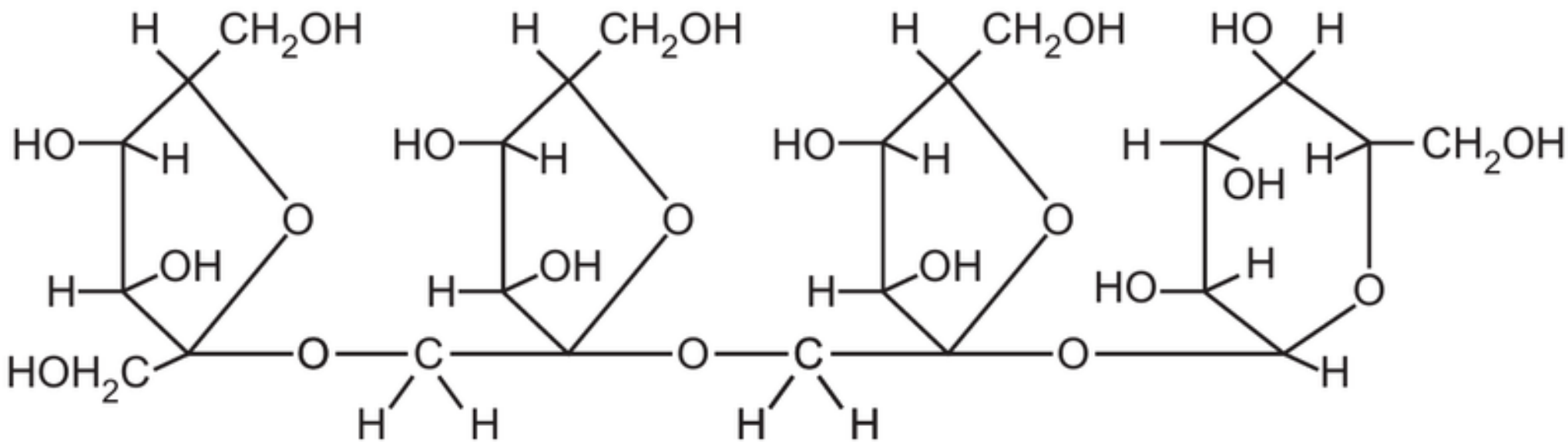


Fig. 6.1

State **three** differences between the structures of nystose and glycogen, **other** than the number of monomers in the molecules.

- 1
-
-
- 2
-
-
- 3
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-

- -

(b) Cells use oligosaccharides to synthesise glycoproteins, which are transported to cell surface membranes.

Describe the roles of the rough endoplasmic reticulum and the Golgi body in synthesising glycoproteins.

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..... [4]

(c) State **one** role of glycoproteins in the cell surface membrane.

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..... [1]

Question No 12 - (9700_w23_21_1)

Subsection Topics: (a) : 4.2 - Movement into and out of cells, 8.2 - Transport of oxygen and carbon dioxide |
(b) : 4.2 - Movement into and out of cells

Scientists measured the concentration of sodium ions and potassium ions in the red blood cells and in the blood plasma of a group of people. The results are shown in Table 1.1.

Table 1.1

	mean concentration of sodium ions /mmol dm ⁻³	mean concentration of potassium ions /mmol dm ⁻³
red blood cells	10	100
blood plasma	100	4

(a) (i) Use the information in Table 1.1 to identify **and** describe the process by which potassium ions enter red blood cells from the blood plasma.

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..... [3]

(ii) Sodium ions and oxygen molecules enter red blood cells.

State **one** similarity and **one** difference between the processes used by sodium ions and oxygen molecules to enter red blood cells.

similarity

.....

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difference

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..... [2]

(iii) Chloride ions move across the membrane of human red blood cells in a process called the chloride shift.

Explain why the chloride shift is important in the transport of carbon dioxide from respiring tissues.

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..... [2]

(b) Scientists studied the uptake of a substance, **F**, by human red blood cells.

The red blood cells were immersed in a solution of substance **F** for 30 minutes. After this time

the scientists recorded two observations:

- the cell surface membrane of the red blood cells showed infoldings (invaginations)
- an increase in the number of vesicles in the cytoplasm.

Identify the process by which substance **F** entered the red blood cells.

..... [1]

[Total: 8]

Question No 13 - (9700_w23_21_4)

Subsection Topics: (a) : 10.1 - Infectious diseases | (b) : 11.1 - The immune system | (c) : 8.3 - The heart

Some people who are infected with HIV develop HIV/AIDS.

- (a) Fig. 4.1 shows the number of people that have been newly infected with HIV (new infections) in 2018 across the world and the percentage changes in the number of new infections since 2010.

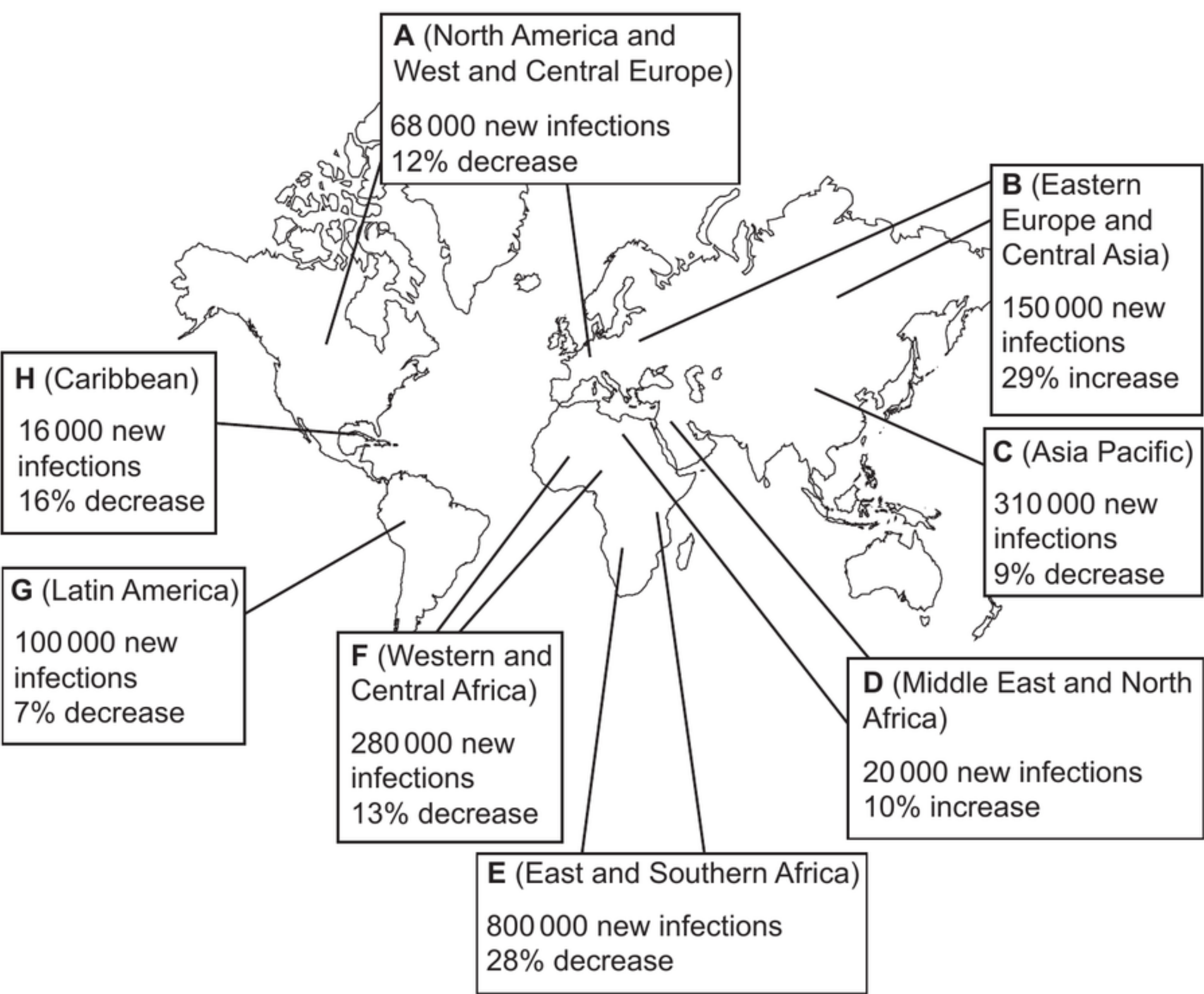


Fig. 4.1

- (i) State the full name of the pathogen HIV.

..... [1]

- (ii) Using **only** the data in Fig. 4.1, state what can be concluded about the change in number of new HIV infections across the world between 2010 and 2018.

You may use the letters in Fig. 4.1 to identify the regions of the world.

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..... [4]

- (b) People who develop HIV/AIDS have fewer T-helper cells as the pathogen destroys these cells. This makes them more susceptible to tuberculosis (TB).

Explain why people with HIV/AIDS are more likely to develop TB.

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..... [4]

- (c) A person infected with HIV may develop a heart condition called cardiac tamponade.

healthy heart

heart with tamponade

pericardium sac

pericardium sac filled with blood

pressure in the pericardium

People with cardiac tamponade experience a variety of symptoms including low blood pressure and an increased breathing rate.

[4]

Question No 14 - (9700_w23_21_3)

Subsection Topics: (a) : 7.2 - Transport mechanisms | (b) : 2.2 - Carbohydrates and lipids | (c) : 7.2 - Transport mechanisms | (d) : 2.4 - Water

Plants have specialised cells for the efficient transport of assimilates.

(a) Table 3.1 shows some of the features of two different types of cell found in plant tissue, which are adapted for the efficient transport of assimilates.

Table 3.1

feature of cell	cell type A	cell type B
cytoplasm	✓	✓
nucleus	✗	✓
mitochondria	few	many
cellulose in the cell wall	✓	✓
ribosomes	✗	✓

Key
✓ present
✗ absent

Many plasmodesmata connect type **A** cells with type **B** cells.

Identify cell type **A and** explain why the plasmodesmata are important.

cell type **A**

explanation

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.....

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[3]

(b) The polysaccharide callose is found in the cell walls of cells close to plasmodesmata.

Fig. 3.1 is a simplified diagram showing the structure of callose. Not all hydrogen atoms are shown.

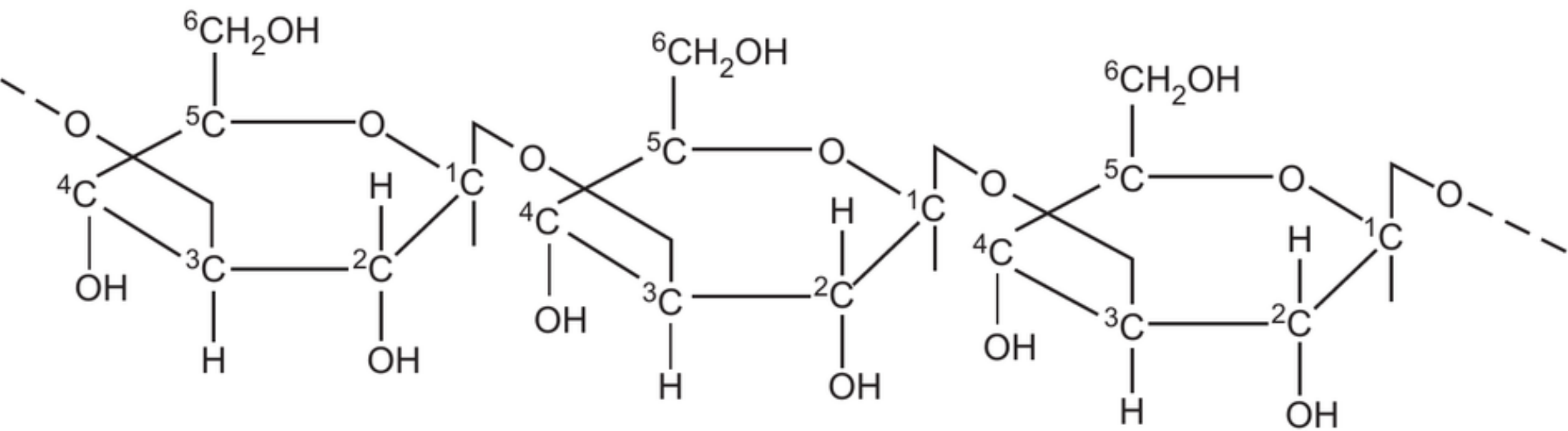


Fig. 3.1

Complete Table 3.2 to compare the structure of a callose molecule with a cellulose molecule.

Table 3.2

feature of polysaccharide	callose molecule	cellulose molecule
monosaccharide used to synthesise the polysaccharide	β-glucose	
bond connecting the monomers		1,4 glycosidic bond
shape of molecule	helix	
orientation of monosaccharides in the molecule		alternate glucose molecules are rotated by 180°

[4]

- (c) Hydrogen bonding is important for movement of water through xylem vessels in a plant.

Describe the roles of hydrogen bonding in the movement of water through xylem vessels.

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[2]

- (d) Water that has travelled through xylem vessels reaches the leaves. Cooling of the leaf occurs as a result of the evaporation of water during transpiration.

Water has a high latent heat of vaporisation because water molecules form hydrogen bonds.

With reference to hydrogen bonding, suggest why cooling of the leaf occurs as a result of evaporation of water during transpiration.

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..... [2]

[Total: 12]

Question No 15 - (9700_w23_22_3)
Subsection Topics: (a) : 8.1 - The circulatory system | (b) : 4.2 - Movement into and out of cells, 11.1 - The immune system | (c) : 1.2 - Cells as the basic units of living organisms, 6.2 - Protein synthesis, 2.3 - Proteins

The liver receives blood from the hepatic artery and from the hepatic portal vein. The hepatic portal vein transports blood from the digestive system.

Hepatocytes are the main cell type of the liver. They have a wide range of functions, including:

- the synthesis of triglycerides and plasma proteins
- detoxifying waste
- energy storage.

(a) The hepatic artery branches from the main artery that transports blood from the heart.

Name the main artery that transports blood to the hepatic artery.
..... [1]

(b) Blood arriving at the liver enters specialised blood vessels known as sinusoids.

Fig. 3.1 is a diagram of part of a sinusoid and surrounding hepatocytes. A second type of cell found in the liver, a Kupffer cell, is also shown.

Kupffer cells are phagocytic cells of the immune system.

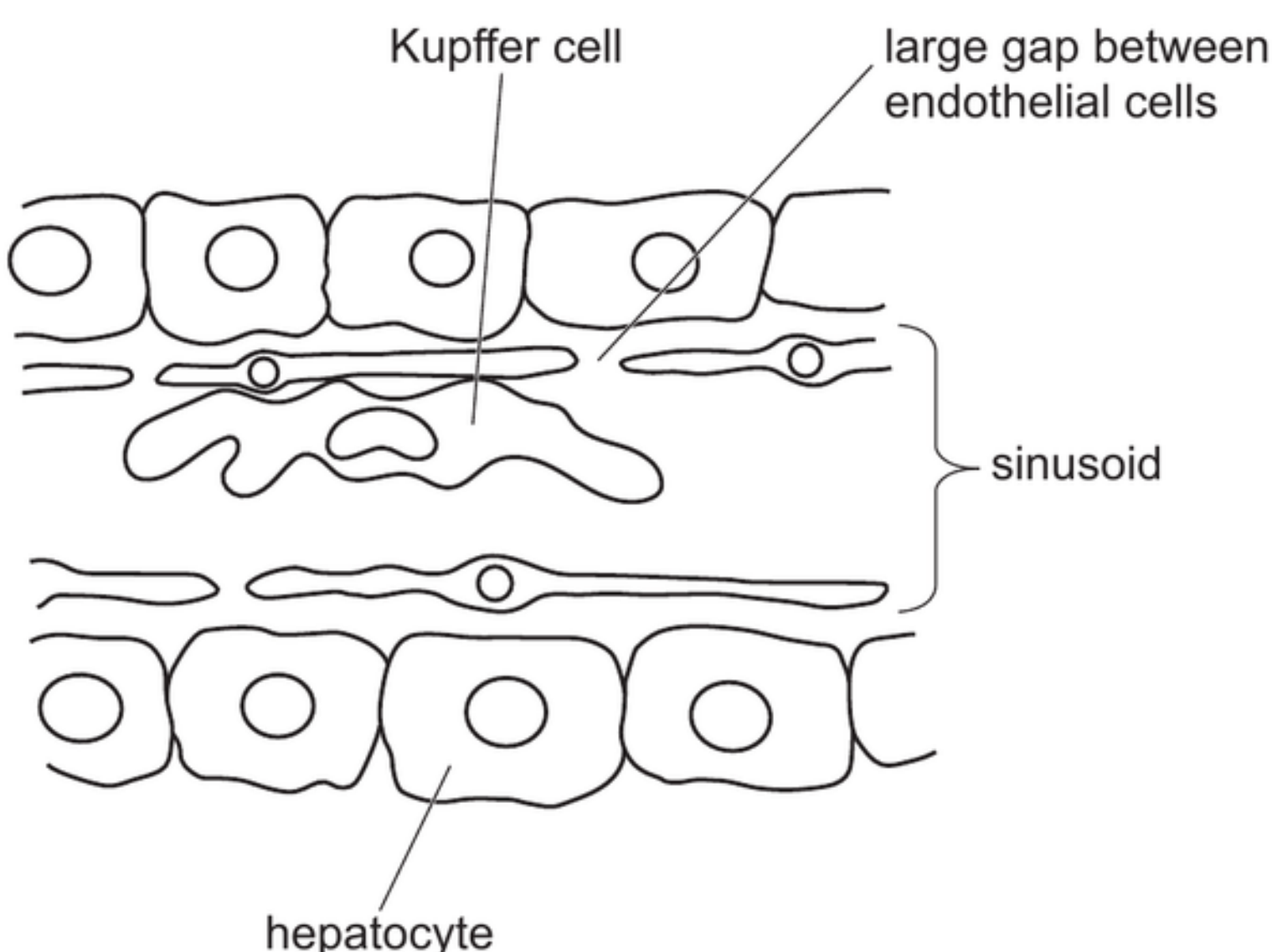


Fig. 3.1

(i) Suggest **one** advantage of having large gaps between the endothelial cells of the sinusoid, as shown in Fig. 3.1.

.....
.....
..... [1]

(ii) In addition to removing bacteria present in the blood inside the sinusoid, Kupffer cells are also able to remove old or damaged red blood cells.

Describe the mode of action of a Kupffer cell in removing and breaking down a damaged red blood cell.

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..... [4]

(c) Fig. 3.2 is a transmission electron micrograph of part of a hepatocyte showing some cell structures.

The peroxisome shown in Fig. 3.2 is a spherical organelle bound by a single membrane. It carries out a variety of enzyme-catalysed metabolic reactions, including detoxification. Some of these reactions require oxygen.



Fig. 3.2

(i) Describe the evidence **visible** in Fig. 3.2, apart from the presence of a peroxisome, that indicates some of the functions of a hepatocyte.

Add labels to Fig. 3.2 to identify the location of any cell structures, if not already labelled, that are part of your evidence.

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..... [3]

(ii) The mitochondria in Fig. 3.2 are larger than the peroxisome.

State **one other** difference, **visible** in Fig. 3.2, between a peroxisome and a mitochondrion.

.....
.....
.....
..... [1]

(iii) Some of the enzymes used within mitochondria can be synthesised by the organelle. Peroxisomes cannot synthesise any of the enzymes that they contain.

Suggest why a mitochondrion can synthesise enzymes, but a peroxisome cannot synthesise enzymes.

.....
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..... [2]

(iv) One of the enzymes present in peroxisomes is catalase. This enzyme catalyses the breakdown of hydrogen peroxide to harmless products.

Suggest why it is useful to the cell for this reaction to take place within peroxisomes.

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..... [2]

Question No 16 - (9700_w23_23_4)

Subsection Topics: (a) : 6.2 - Protein synthesis | (b) : 6.1 - Structure of nucleic acids and replication of DNA, 6.2 - Protein synthesis | (c) : 1.2 - Cells as the basic units of living organisms, 1.1 - The microscope in cell studies | (d) : 4.2 - Movement into and out of cells

Fig. 4.1 is a diagram showing the transcription of part of the *COL1A2* gene that codes for a collagen polypeptide. The part of the *COL1A2* gene shown is a section of exon. Structure **A** represents an enzyme involved in transcription.

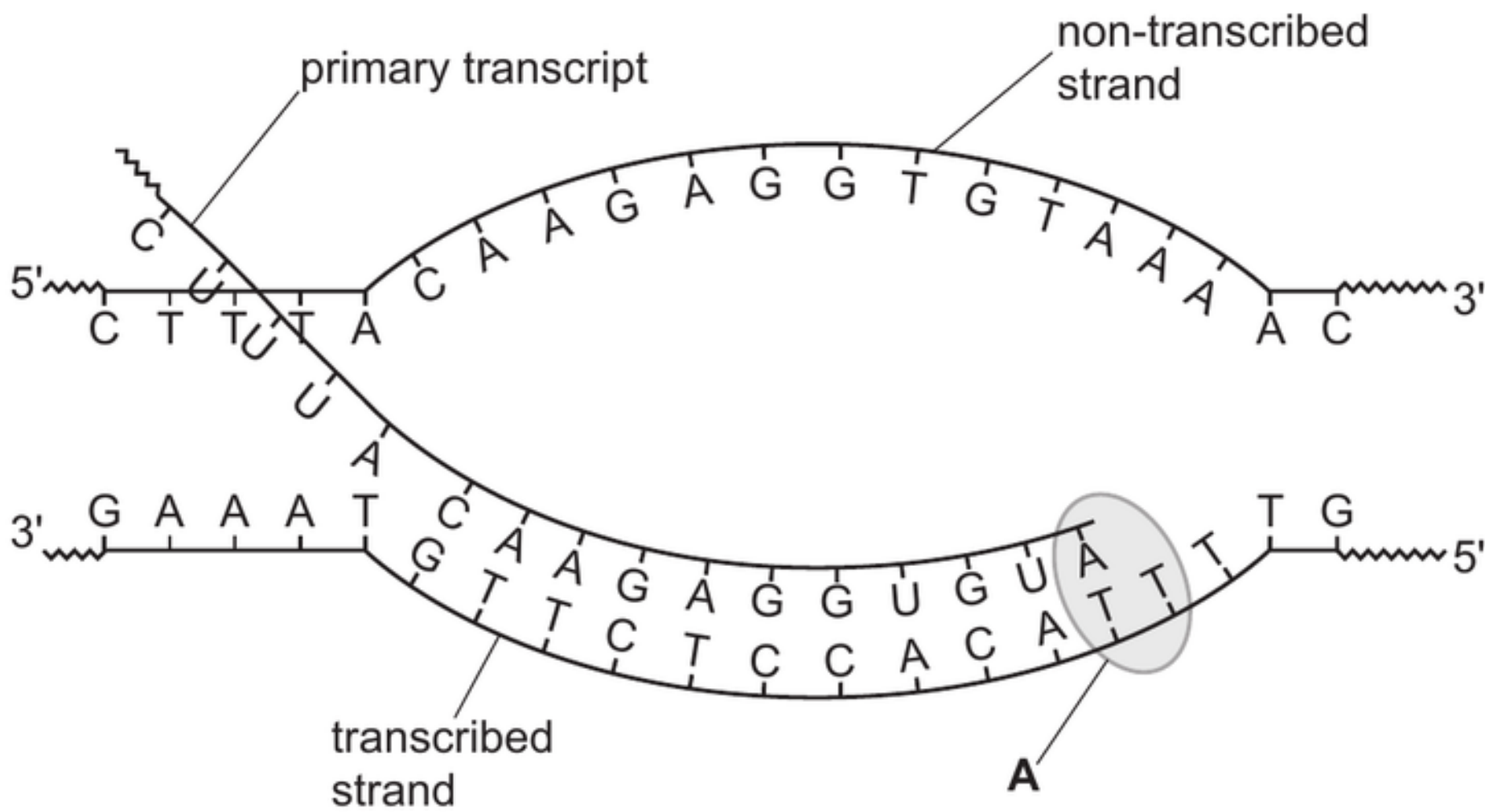
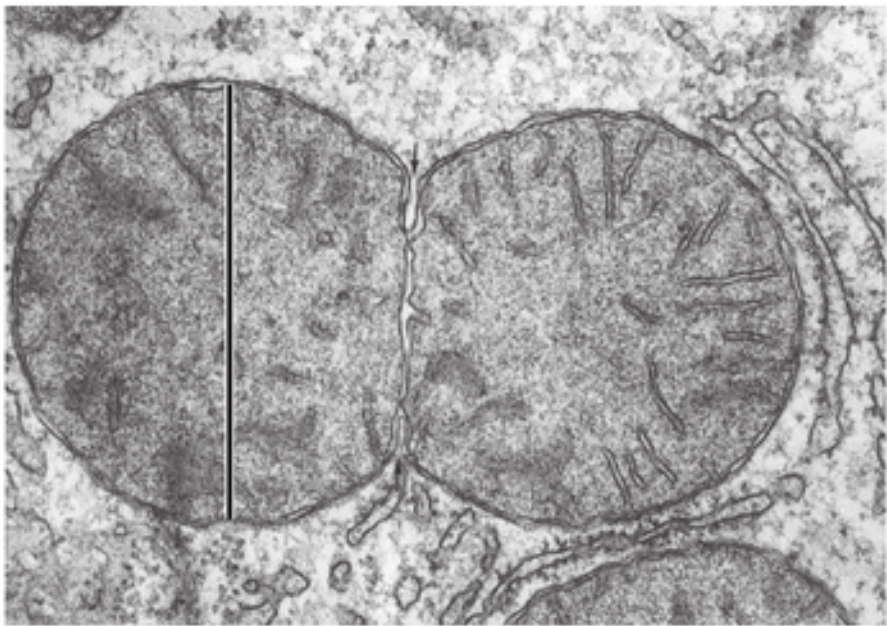


Fig. 4.1

- (a) (i) Name the enzyme labelled **A** in Fig. 4.1.
- [1]
- (ii) Name the bond that forms between the nucleotides in the primary transcript.
- [1]
- (b) (i) State the number of amino acids that are coded for by the sequence of nucleotides on the primary transcript shown in Fig. 4.1.
- [1]
- (ii) Use the information in Fig. 4.1 to explain why one of the strands of DNA is **not** transcribed.
-
-
-
-
-
- [2]

- (c) New mitochondria are formed when a mitochondrion divides into two.

Fig. 4.2 is a transmission electron micrograph of a mitochondrion that is dividing.



magnification $\times 50\,000$

Fig. 4.2

- (i) State **two** features of mitochondria that are **visible** in Fig. 4.2.
- 1
- 2

[2]

(ii) The line on Fig. 4.2 shows the diameter of one of the mitochondria.

Calculate the actual diameter of the mitochondrion.

Give your answer to one significant figure.

answer = μm [1]

(d) Mitochondrial DNA codes for some polypeptides of proteins used within the mitochondrion. Some of the proteins allow movement of ions into and out of the mitochondria.

Outline the ways in which ions can move into mitochondria.

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..... [3]

[Total: 11]

Question No 17 - (9700_m22_22_1)

Subsection Topics: (a) : 4.2 - Movement into and out of cells | (b) : 7.2 - Transport mechanisms | (c) : 7.2 - Transport mechanisms

(a) Table 1.1 shows three of the processes by which substances in solution can move across cell membranes. It also lists five statements that may apply to each of these three processes.

Complete Table 1.1 to show which of the statements apply to each of the three processes shown.

Use a tick (✓) to show that the statement applies or a cross (X) to show that the statement does not apply.

Each box must contain a tick or a cross.

The first row has been completed for you.

Table 1.1

statement	process		
	active transport	facilitated diffusion	simple diffusion
movement of oxygen into a red blood cell	X	X	✓
occurs in both animal and plant cells			
uses carrier proteins			
movement of non-polar molecules between the fatty acid tails of the phospholipid molecules			
movement of ions down a concentration gradient			

[4]

(b) Fig. 1.1 is a simplified diagram representing a transverse section of part of a young root. The diagram is not to scale.

(i) On Fig. 1.1 draw a label line and label with the letter **C** to identify the Casparian strip. [1]

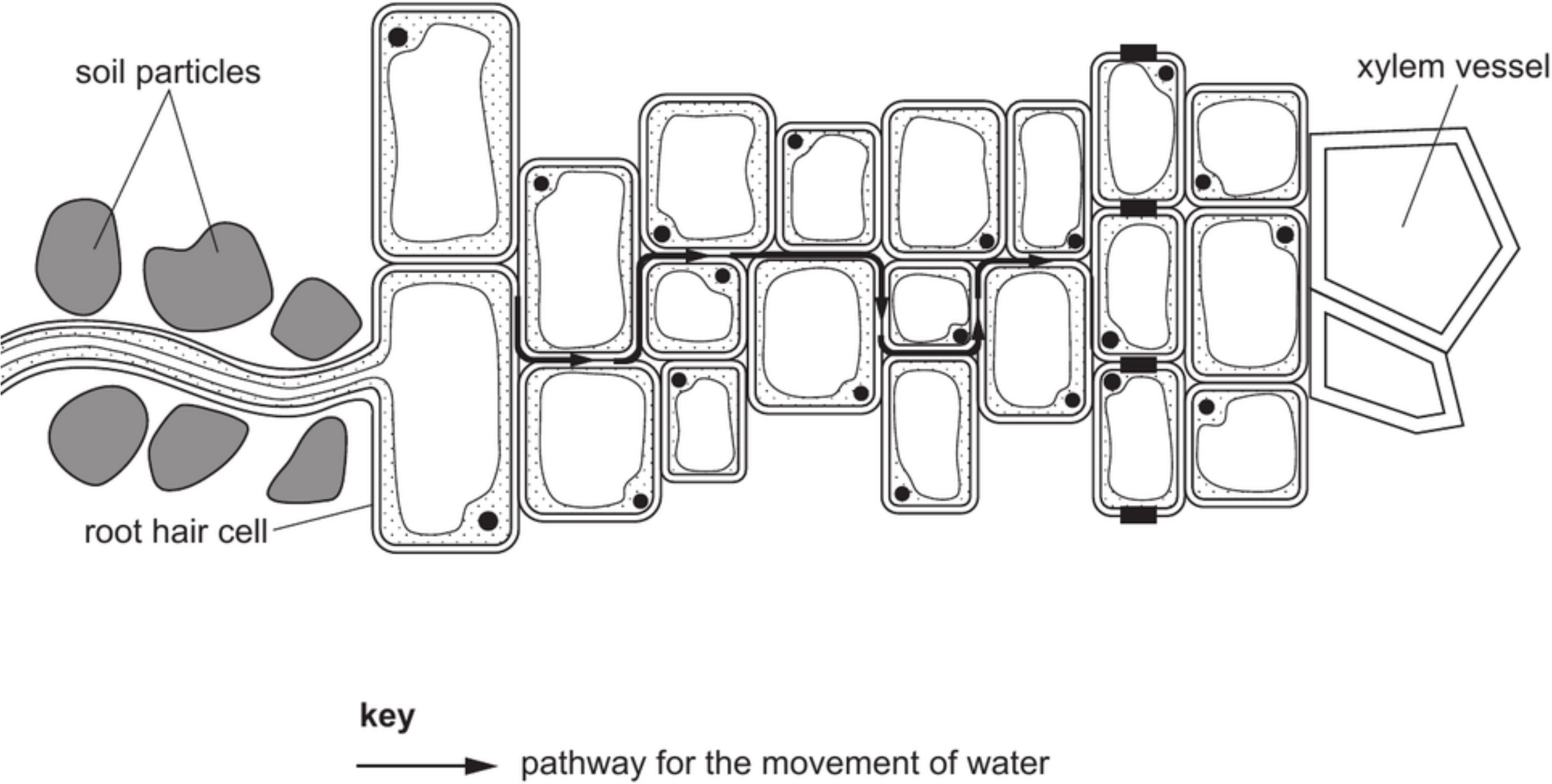


Fig. 1.1

(ii) Root hairs measure approximately 5µm in diameter and 500µm in length.

Explain how this adapts root hairs for the absorption of water.

.....

.....

..... [1]

(iii) Name the pathway for the movement of water shown by the arrows in Fig. 1.1.

..... [1]

(c) Water enters the xylem vessels shown in Fig. 1.1.

Explain how water moves up the xylem vessels to the leaves in a continuous column.

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..... [3]

Question No 18 - (9700_s22_22_1)
Subsection Topics: (a) : 1.1 - The microscope in cell studies | (b) : 1.1 - The microscope in cell studies |
(c) : 4.2 - Movement into and out of cells | (d) : 5.1 - Replication and division of nuclei and cells

Epithelial cells in the small intestine have cell structures known as microvilli. The microvilli of these cells are found only on the surface that borders the gut lumen.

Fig. 1.1 shows images of microvilli of intestinal epithelial cells. These images have been obtained using a scanning electron microscope and a transmission electron microscope.

Fig. 1.1**A** is at a different magnification to Fig. 1.1**B**.

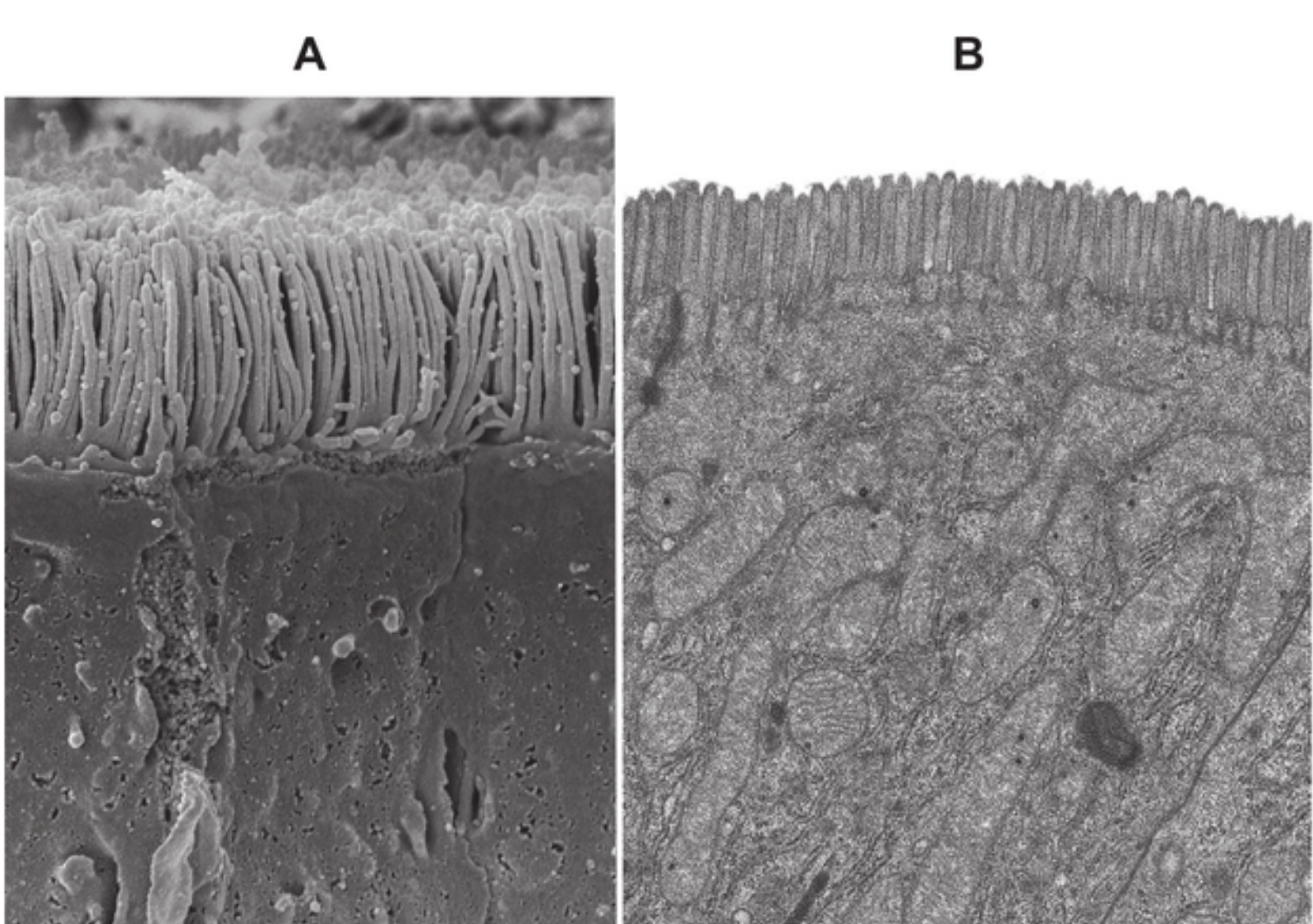


Fig. 1.1

(a) With reference to Fig. 1.1, state how it is possible to distinguish between a scanning electron micrograph and a transmission electron micrograph.

[1]

(b) The approximate length of a microvillus is 1 μm .

Outline the method you would use to estimate the magnifications of the images shown in Fig. 1.1.

[2]

(c) One role of an intestinal epithelial cell is the absorption of glucose from the gut lumen into the circulatory system. This involves different membrane transport proteins.

The events occurring in an intestinal epithelial cell during the absorption of glucose are summarised in Fig. 1.2.

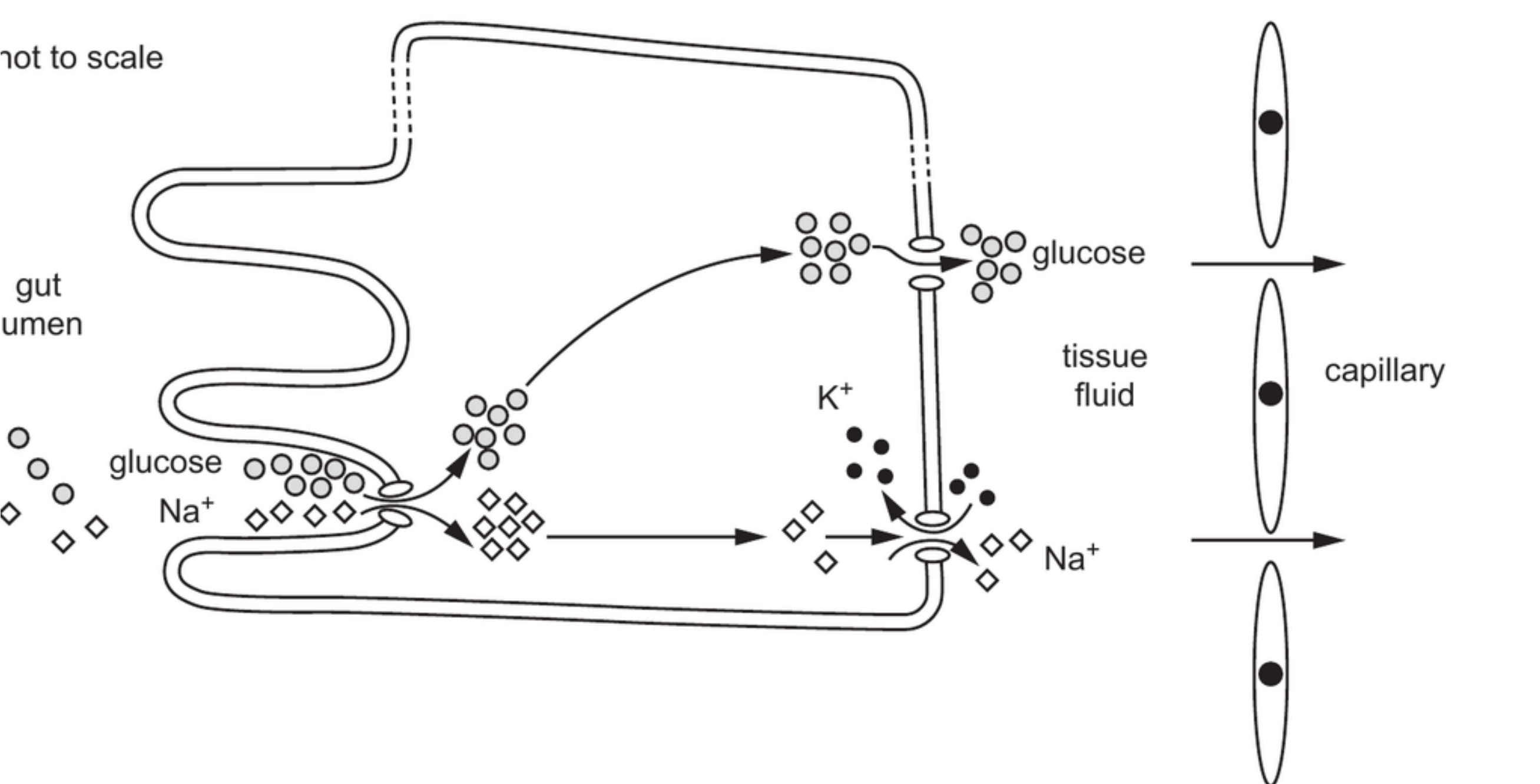


Fig. 1.2

- Sodium ions (Na^+) are removed from the cell by active transport through a transport protein known as a sodium-potassium (Na^+/K^+) pump.
 - This decreases the concentration of Na^+ in the cell compared to the gut lumen.
 - Glucose molecules are cotransported with Na^+ into the cell from the gut lumen.
 - Glucose molecules are transported out of the cell into the tissue fluid down a concentration gradient.
- (i)** Active transport involves water-soluble substances, such as Na^+ and K^+ , and the use of ATP to provide the energy needed for their transport through carrier proteins.

Outline **other** features of active transport.

(ii) Glucose molecules enter the cell through a membrane protein.

Suggest why glucose molecules need to be cotransported with Na^+ when it enters the cell through the membrane protein.

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..... [2]

(iii) Explain how microvilli increase the uptake of glucose into an intestinal epithelial cell.

.....
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.....
..... [2]

(d) Stem cells are also located in the wall of the small intestine. These cells divide by mitosis continuously.

Suggest **and** explain the importance of mitosis by stem cells in the small intestine.

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..... [4]

[Total: 13]

Question No 19 - (9700_s22_23_5)

Subsection Topics: (a) : 4.1 - Fluid mosaic membranes | (b) : 3.2 - Factors that affect enzyme action | (c) : 6.1 - Structure of nucleic acids and replication of DNA | (d) : 4.1 - Fluid mosaic membranes

Arachidonic acid is a fatty acid that is a common component of phospholipids.

Phospholipids can be used as a source of arachidonic acid when it is metabolised within cells in an enzyme-catalysed pathway known as the cyclooxygenase (COX) pathway.

The final products of the COX pathway can be different in different cell types, causing a range of responses. In some cells, the products are involved in the inflammatory response, which is a response by the body to infection. In other cells, cell division is stimulated.

Fig. 5.1 shows the **first reaction** in the COX pathway. This reaction is catalysed by an enzyme known as COX-2.

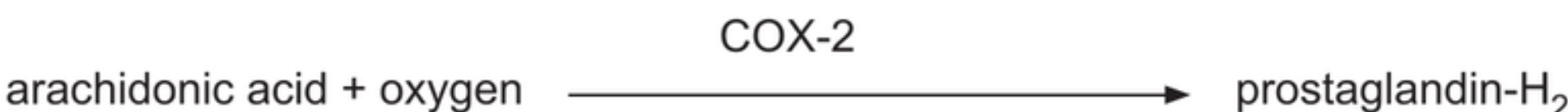


Fig. 5.1

- (a) The enzymes involved in the COX pathway are located in the membrane of rough endoplasmic reticulum.

Suggest the advantages to the cell of enzyme pathways being located in cell membranes, rather than in the cytosol of the cell (fluid portion of cytoplasm).

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..... [2]

- (b) During an inflammatory response, compounds produced by the COX pathway cause an increased sensitivity to pain.

Some anti-inflammatory drugs are reversible competitive inhibitors of COX-2.

Fig. 5.2 shows how increasing arachidonic acid concentration affects COX-2 activity.

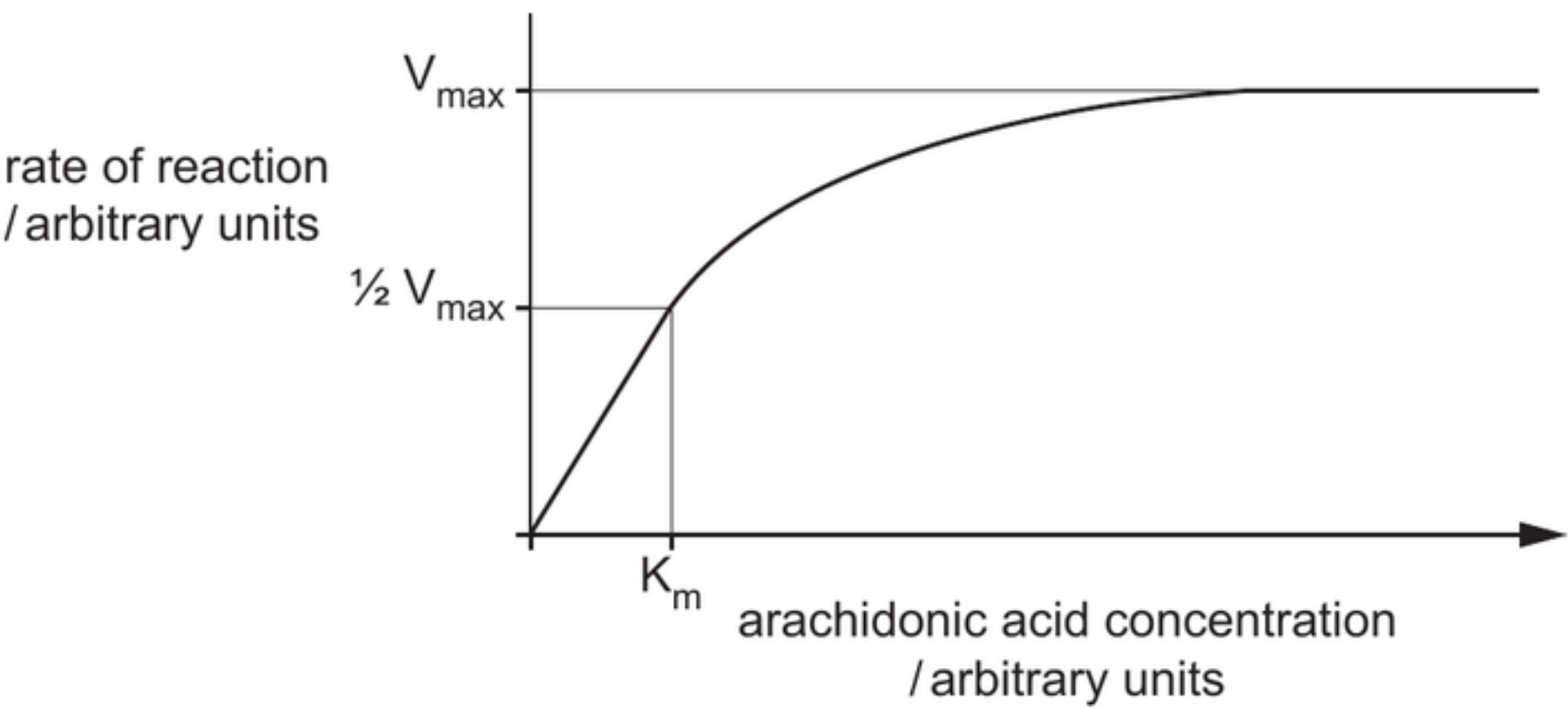


Fig. 5.2

.....

- (i) Sketch on Fig. 5.2 the curve obtained if an anti-inflammatory drug, which is a **competitive** inhibitor, is present with arachidonic acid. [1]
- (ii) Complete the statements to show whether the maximum rate of reaction (V_{max}) and the Michaelis-Menten constant (K_{m}) of COX-2 **increases**, **decreases**, or **stays the same** in the presence of a competitive inhibitor.

In the presence of a competitive inhibitor:

V_{max} of COX-2

K_{m} of COX-2 [2]

- (c) COX-2 is composed of two identical polypeptides. The enzyme is produced when a gene, *PTGS2*, located on chromosome 1, is switched on and transcription begins.

- (i) Using gene *PTGS2* and enzyme COX-2 as examples, explain what is meant by a gene.
-
-
-
- [2]

- (ii) Some mutations in *PTGS2* lead to an increased rate of transcription. These mutations have been linked to an increased risk of certain types of cancer.

Suggest why mutations in *PTGS2* may increase the risk of cancer.

.....

.....

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..... [2]

(d) Fig. 5.3 shows the molecular structure of arachidonic acid. Not all hydrogen atoms are shown.

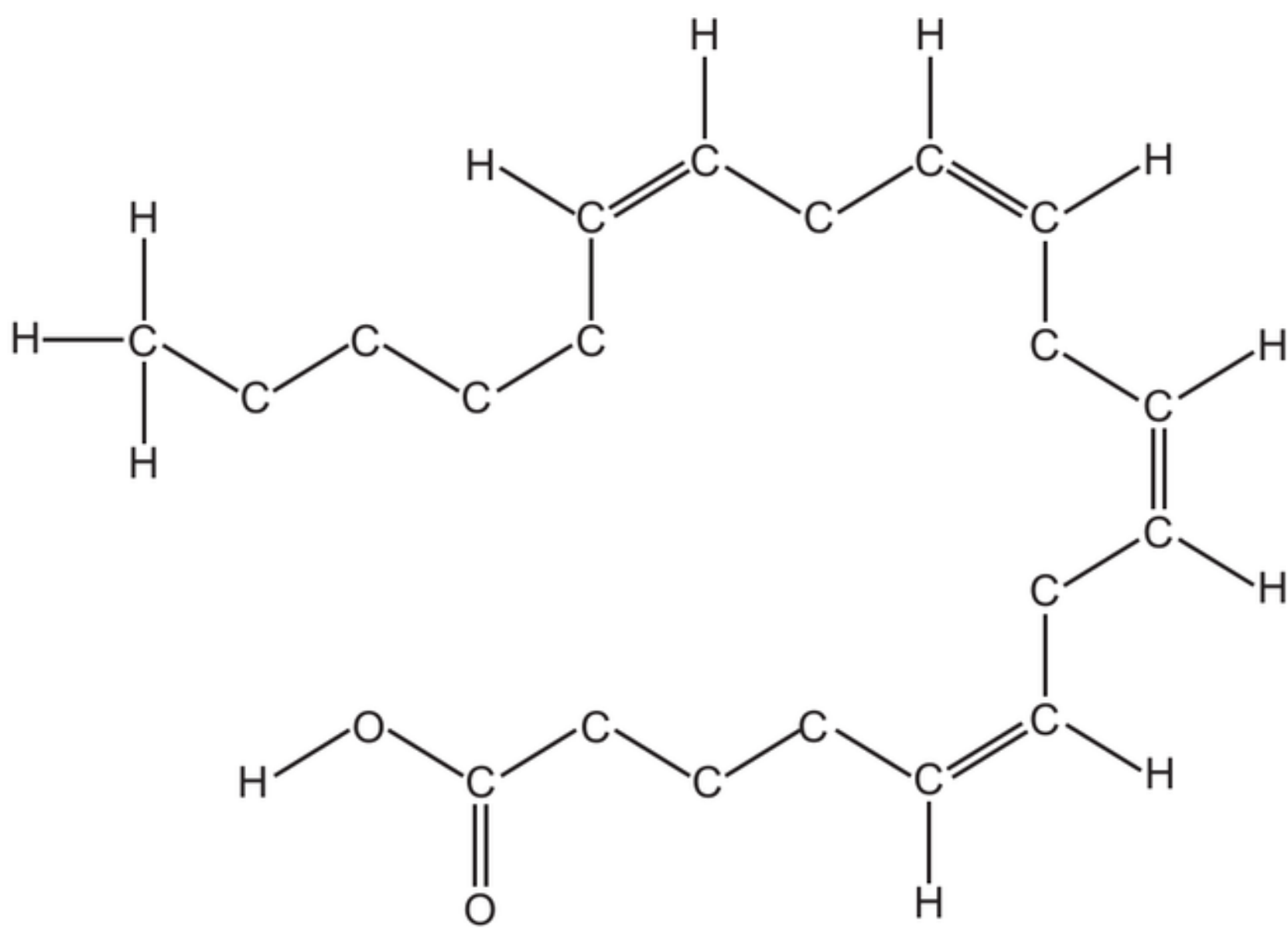


Fig. 5.3

With reference to Fig. 5.3, explain why increasing the proportion of phospholipids with arachidonic acid in a cell will increase the fluidity of the cell surface membrane of the cell.

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..... [3]

Question No 20 - (9700_s22_23_2)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 4.2 - Movement into and out of cells | (c) : 2.2 - Carbohydrates and lipids | (d) : 1.2 - Cells as the basic units of living organisms

Bacterial cells are prokaryotic. The cells of plants are described as eukaryotic.

(a) Complete the passage comparing a bacterial cell with a plant cell.

A bacterial cell and a plant cell have a cell wall, but the main component of the bacterial cell wall is and not cellulose. The same organelle is used for protein synthesis in both cell types, but a bacterial cell only has smaller, 70S, A bacterial cell does not have a large surrounded by a tonoplast.

[3]

(b) Protoplasts are plant cells that have had their cell walls removed by treatment with enzymes. Scientists often use protoplasts when researching ways to improve the yield of crop plants.

Fig. 2.1 is a scanning electron micrograph of protoplasts of cells from the tobacco plant, *Nicotiana tabacum*.

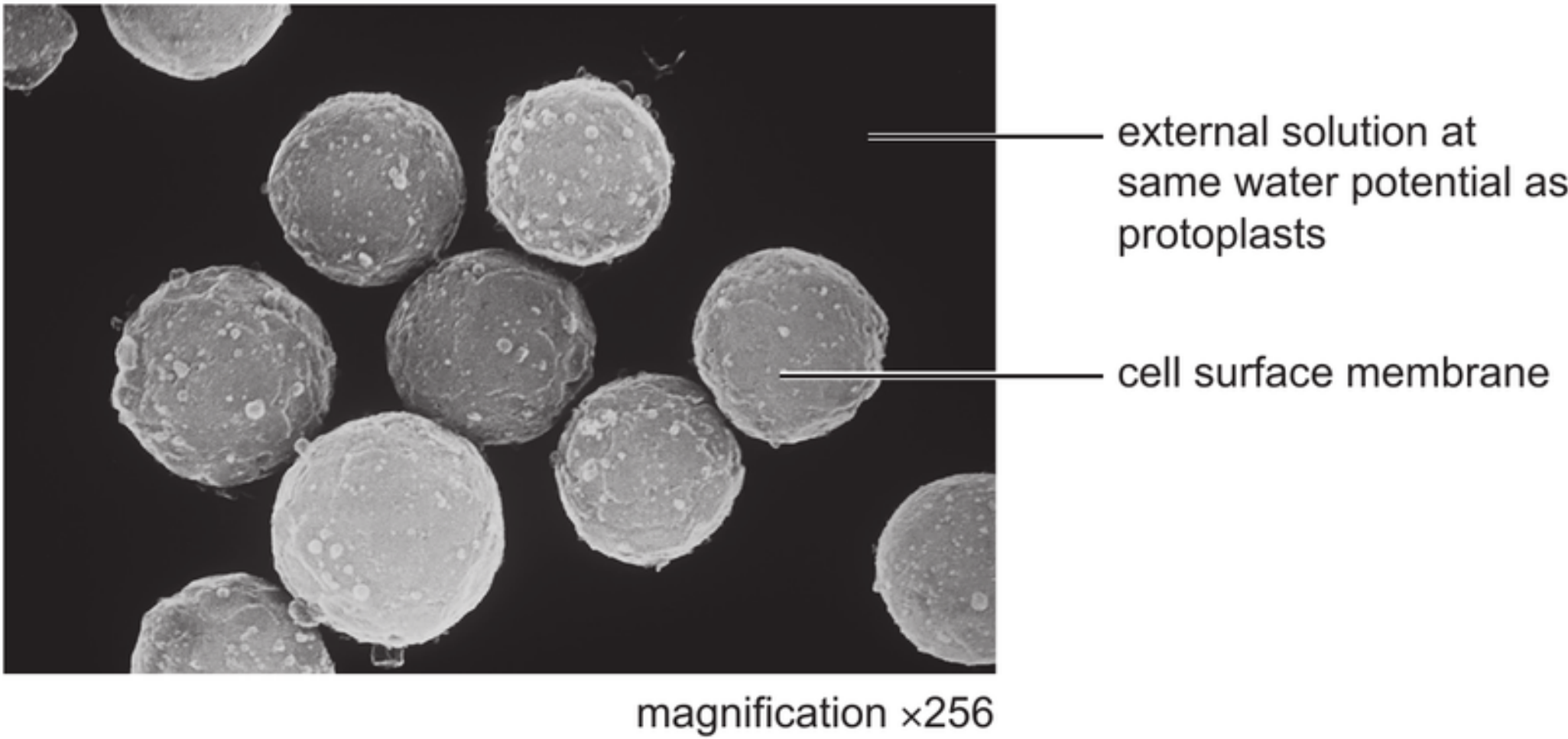


Fig. 2.1

Explain why scientists keep the protoplasts in a solution that has the same water potential as the cell.

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.....
..... [2]

After protoplast treatment, the cells can be stimulated to synthesise new cell wall material.

Fig. 2.2 is at a higher magnification than Fig. 2.1 and shows a scanning electron micrograph of part of a protoplast in an early stage of cell wall synthesis.

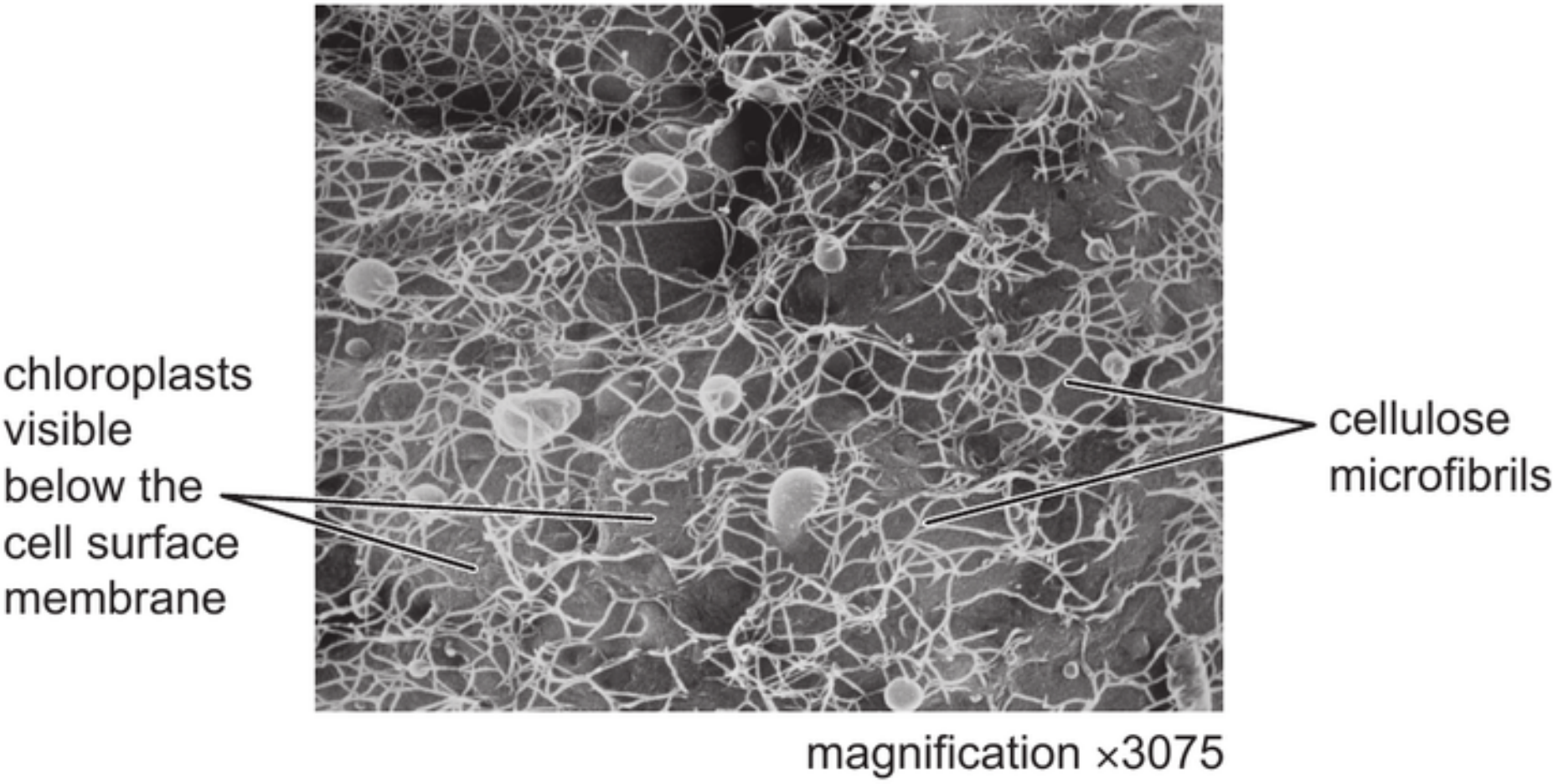


Fig. 2.2

(c) The cellulose microfibrils visible in Fig. 2.2 will form cellulose fibres. Each microfibril is formed

(c) The cellulose microfibrils visible in Fig. 2.2 will form cellulose fibres. Each microfibril is formed from cellulose molecules. Each cellulose molecule is a polymer of β -glucose.

(i) Describe the structure of a cellulose molecule **and** a cellulose microfibril.

.....

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..... [3]

(ii) Name **one** substance that may be added to the network formed by the cellulose microfibrils in the formation of a cell wall.

..... [1]

(d) Name the type of plant cell that could have been used to produce the protoplast shown in Fig. 2.2.

..... [1]

[Total: 10]

Cathelicidin LL-37 is a cell signalling compound that stimulates many different cells in humans. One role of cathelicidin LL-37 is stimulating the production of endothelial cells in the formation of capillaries during wound healing.

- (a)

(i)

Explain how it is possible for many different cell types to respond to the same cell signalling compound.

[2]

(ii)

Describe the appearance of the endothelial cells of a capillary.

[2]

Cathelicidin LL-37 is a protein composed of 37 amino acids.

Table 5.1 shows:

- the sequence of the first 10 amino acids in the primary structure of cathelicidin LL-37
- DNA triplets in the non-transcribed strand in the gene that codes for the first 10 amino acids in the primary structure of cathelicidin LL-37.

Table 5.1										
amino acid position	1	2	3	4	5	6	7	8	9	10
amino acid	leu	leu	gly	asp	phe	phe	arg	lys	ser	lys
DNA triplet	CTG	CTG	GGT	GAT	TTC	TTC	CGG	AAA	TCT	AAA

Table 5.2 shows the triplets of bases in **DNA** and the amino acids for which they code.

Table 5.2											
second base											
first base		T		C		A		G			third base
	T	TTT	phe	TCT	ser	TAT	tyr	TGT	cys	T	
		TTC		TCC		TAC		TGC		C	
		TTA	leu	TCA		TAA	stop	TGA	stop	A	
		TTG		TCG		TAG		TGG	try	G	
	C	CTT	leu	CCT	pro	CAT	his	CGT	arg	T	
		CTC		CCC		CAC		CGC		C	
		CTA		CCA		CAA	gln	CGA		A	
		CTG		CCG		CAG		CGG		G	
	A	ATT	ile	ACT	thr	AAT	asp	AGT	ser	T	
		ATC		ACC		AAC		AGC		C	
		ATA	ile	ACA		AAA	lys	AGA	arg	A	
		ATG	met	ACG		AAG		AGG		G	
	G	GTT	val	GCT	ala	GAT	asp	GGT	gly	T	
		GTC		GCC		GAC		GGC		C	
		GTA		GCA		GAA	glu	GGA		A	
		GTG		GCG		GAG		GGG		G	

- (b)

Mutations of DNA base sequences in a gene can affect the primary structure of proteins.

Use the information in Table 5.1 and Table 5.2 to suggest the effect on the primary structure of cathelicidin LL-37 of:

(i)

the substitution of the base T with the base A in the middle of the triplet at position 5

[1]

(ii)

the deletion of base T in the triplet at position 2

.....
.....
..... [2]

(iii) the insertion of base G between bases G and T in the triplet at position 3.

.....
.....
..... [2]

(c) The genetic code is described as universal.

Explain why the genetic code is described as universal.

.....
.....
..... [1]

(d) Use Table 5.2 to explain why some mutations have no effect on the primary structure of a protein.

.....
.....
.....
.....
..... [2]

Question No 22 - (9700_m21_22_3)

Subsection Topics: (a) : 11.1 - The immune system | (b) : 1.2 - Cells as the basic units of living organisms |
(c) : 4.2 - Movement into and out of cells

T-helper lymphocytes and Leydig cells are two types of mammalian cells. The main role of T-helper lymphocytes and Leydig cells is to synthesise and secrete cell-signalling molecules.

- T-helper lymphocytes synthesise proteins known as cytokines.
- Leydig cells synthesise the steroid (lipid) hormone testosterone from cholesterol. Leydig cells also synthesise cholesterol.

(a) State **one** way in which cytokines are involved in an immune response.

.....

.....

..... [1]

(b) Fig. 3.1 shows part of a mammalian cell.



Fig. 3.1

(i) State, with reasons, whether Fig. 3.1 shows part of a Leydig cell or part of a T-helper lymphocyte.

.....

.....

.....

.....

(ii) Underline the correct name for the type of image shown in Fig. 3.1 **and** explain your choice.

photomicrograph

scanning electron micrograph

transmission electron micrograph

explanation

.....

.....

.....

..... [2]

(c) Testosterone molecules and cytokine molecules are transported in the circulatory system to reach their target cells. Testosterone molecules are able to enter their target cells and bind to receptors within the cytoplasm.

(i) Outline **one** way in which testosterone molecules could enter their target cells.

.....

.....

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..... [2]

(ii) Cytokine molecules are not able to enter their target cells.

Suggest **and** explain why cytokine molecules are **not** able to cross the cell surface membrane to enter their target cells.

.....

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..... [2]

Question No 23 - (9700_s21_21_6)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 11.1 - The immune system | (d) : 3.1 - Mode of action of enzymes | (e) : 4.2 - Movement into and out of cells

Lysosomes are cell structures that contain enzymes known as acid hydrolases.

Fig. 6.1 shows some processes that occur in animal cells.

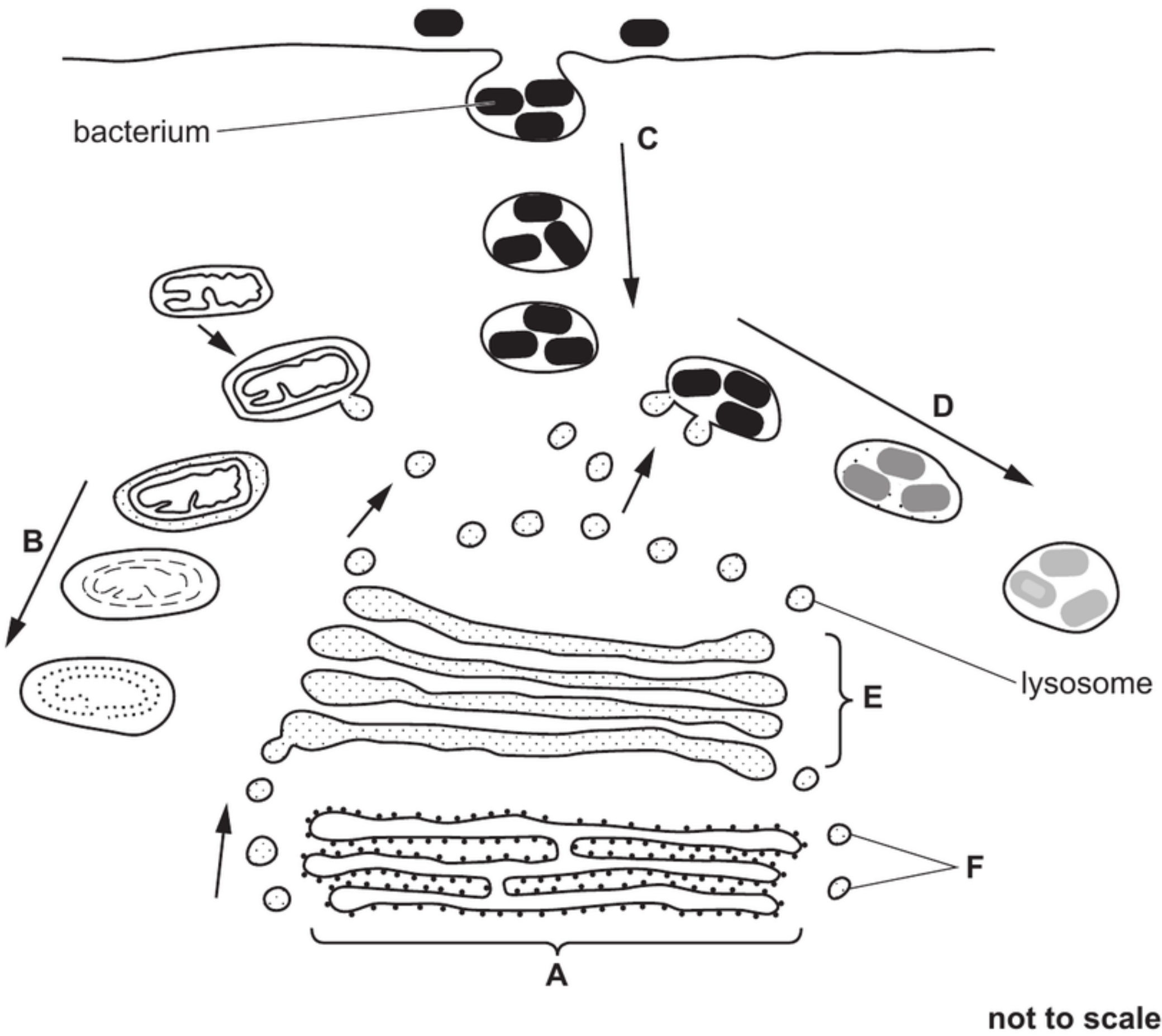


Fig. 6.1

(a) Name the cell structures labelled **A** and **E**.

A

E

[2]

(b) State the function of the structures labelled **F**.

.....

..... [1]

(c) Name the process by which bacteria are taken into the cell at **C**.

..... [1]

(d) With reference to the processes occurring at **B** and at **D** in Fig. 6.1, outline the role of acid hydrolases in lysosomes.

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..... [3]

(e) Carrier proteins in the membranes of lysosomes maintain a lower pH than the surrounding cytoplasm by moving hydrogen ions.

Suggest how the carrier proteins maintain the lower pH within the lysosomes.

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..... [2]

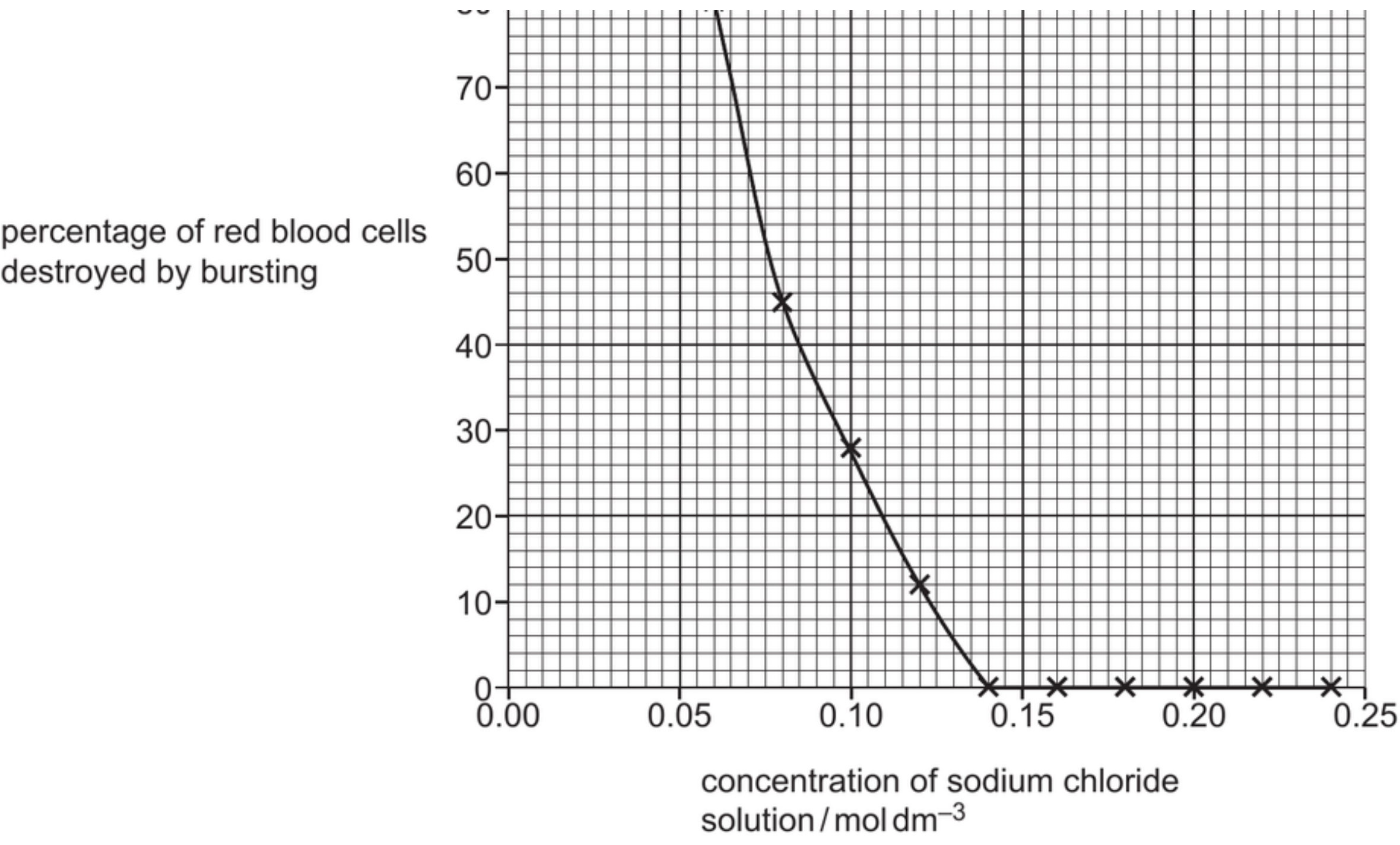


Fig. 3.2

Describe **and** explain the effects on red blood cells of immersion in different concentrations of sodium chloride as shown in Fig. 3.2.

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[4]

Question No 25 - (9700_s21_22_3)

Subsection Topics: (a) : 8.1 - The circulatory system | (b) : 4.2 - Movement into and out of cells | (c) : 11.1 - The immune system | (d) : 1.2 - Cells as the basic units of living organisms | (e) : 2.3 - Proteins

In mammals, some cell signalling molecules are steroid (lipid) hormones. These hormones are transported in the bloodstream to reach capillary networks.

At a capillary network, hormones pass out of the blood into tissue fluid.

(a) Fig. 3.1 is a diagram of a capillary network.

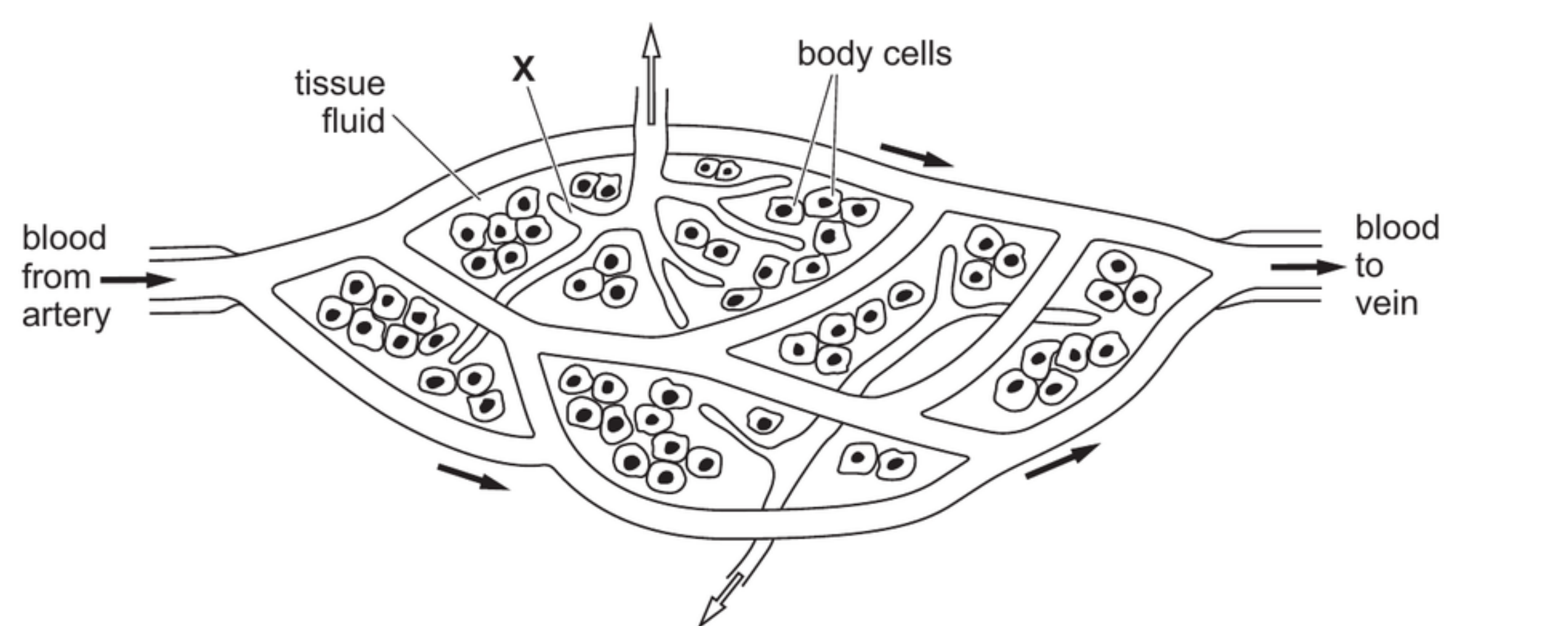


Fig. 3.1

(i) Describe the **differences** between the blood arriving at the arterial end of the capillary network and the tissue fluid surrounding the body cells.

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..... [3]

(ii) Not all the tissue fluid passes back into the blood capillaries to enter the bloodstream. Some of the tissue fluid drains into blind-ended vessels, such as vessel **X** shown in Fig. 3.1.

Name the fluid that is formed in vessel **X**.

..... [1]

Hormone **S** is a steroid hormone involved in cell signalling.

Fig. 3.2 shows the sequence of events that occurs when hormone **S** enters a target cell.

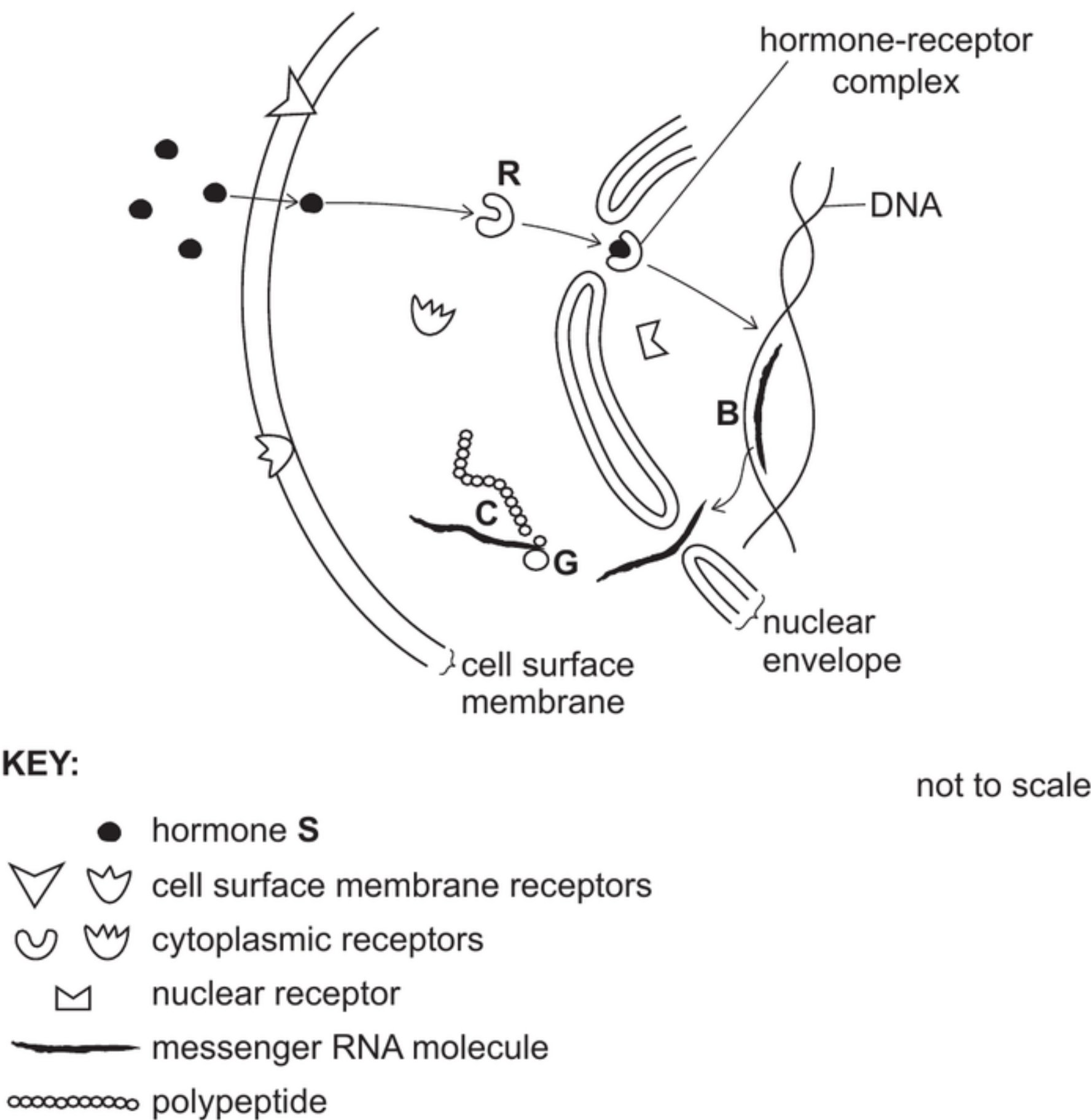


Fig. 3.2

(b) Explain why hormone **S**, shown in Fig. 3.2, does not need to pass through a transport protein to enter the cytoplasm of the target cell.

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.....

..... [2]

(c) The target cell can respond to other cell signalling molecules in addition to hormone **S**. The cell has receptors in the cell surface membrane, in the cytoplasm and in the nucleus.

Explain why hormone **S** binds only with receptor **R** in the cytoplasm and **not** with the other receptors shown in Fig. 3.2.

.....

.....

(d) The hormone-receptor complex shown in Fig. 3.2 enters the nucleus and binds to DNA. This

switches on a gene coding for a polypeptide that is synthesised in the cytoplasm.

(i) Name the structure through which the hormone-receptor complex enters the nucleus.

..... [1]

(ii) Name the processes occurring at **B** and **C**.

B

C [2]

(iii) Name structure **G**.

..... [1]

(e) Cell signalling by hormone **S** results in the production of a functioning globular protein molecule composed of three identical polypeptide chains.

After the synthesis of these polypeptides, changes need to occur to form the functioning globular protein molecule.

Outline the changes that need to occur to form the functioning globular protein molecule.

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..... [4]

Question No 26 - (9700_s21_22_5)

Subsection Topics: (a) : 1.2 - Cells as the basic units of living organisms | (b) : 1.2 - Cells as the basic units of living organisms | (c) : 3.2 - Factors that affect enzyme action | (d) : 3.2 - Factors that affect enzyme action

Fig. 5.1 is a transmission electron micrograph showing parts of two plant cells. The function of the middle lamella is cell-to-cell adhesion. The middle lamella is composed of a polysaccharide known as pectin.

Pectin interacts with the polysaccharides cellulose and hemicellulose in the cell walls of the plant cells so that the cell walls are held close together, as shown in Fig. 5.1.

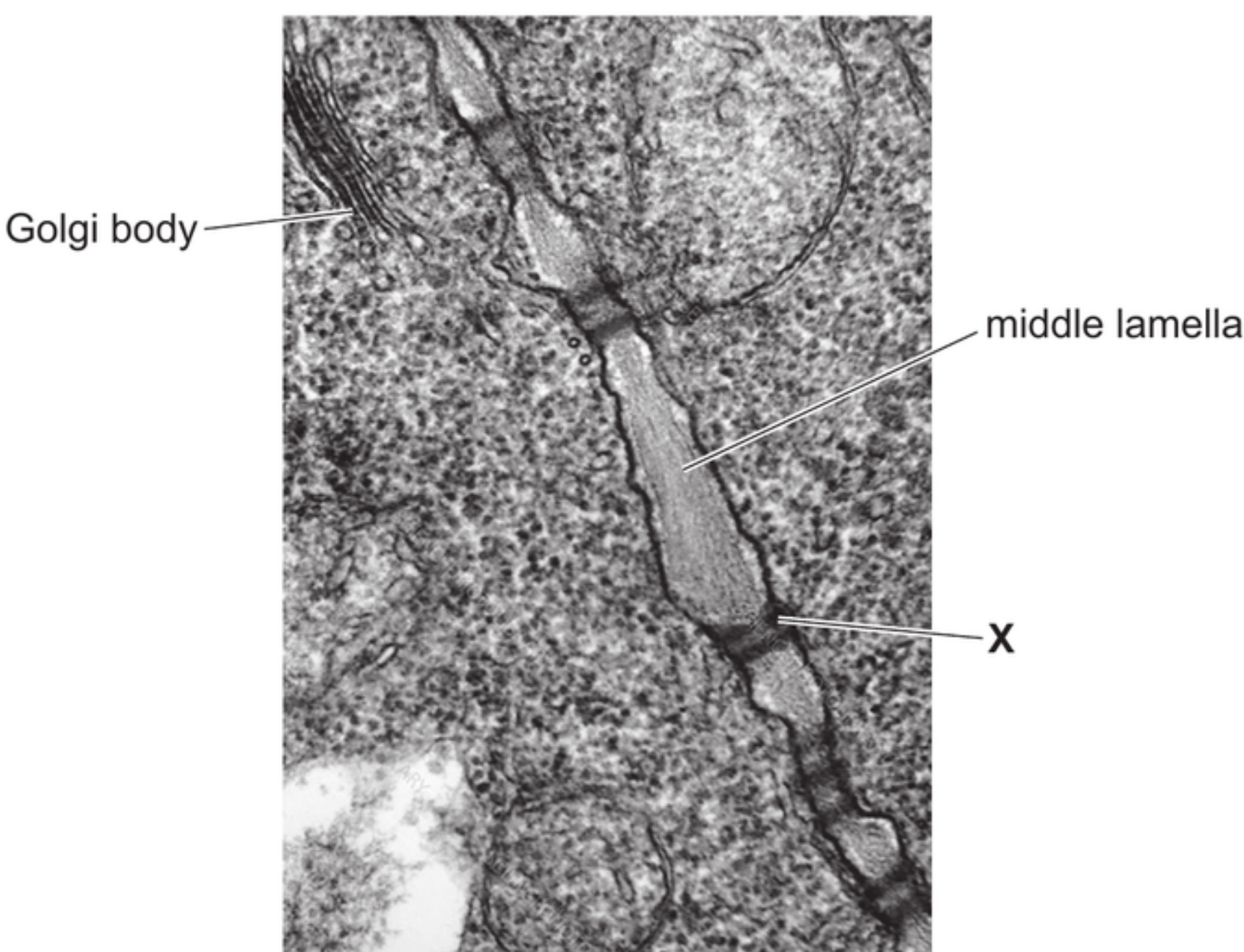


Fig. 5.1

(a) Cell structure **X** in Fig. 5.1 is a cytoplasmic channel with strands of cytoplasm passing through the cell walls of the two cells.

Name cell structure **X** and state **one** function of this cell structure.

name

function

..... [2]

(b) Researchers have discovered that pectin is synthesised within the Golgi body. Golgi vesicles containing pectin are moved to the cell surface membrane for release.

(i) Suggest why researchers would **not** have investigated ribosomes as being the possible location for the synthesis of pectin.

.....

..... [1]

(ii) Name the mechanism that is used to transport pectin out of the cell.

..... [1]

Juices that are extracted commercially from fruits can be made less cloudy by the breakdown of the cell wall using the enzymes cellulase, pectinase and xylanase:

- cellulase hydrolyses cellulose
- pectinase hydrolyses pectin
- xylanase hydrolyses hemicellulose.

(c) Fig. 5.2 is a graph showing the effect of cellulose concentration on the activity of cellulase, which is used in making fruit juice less cloudy.

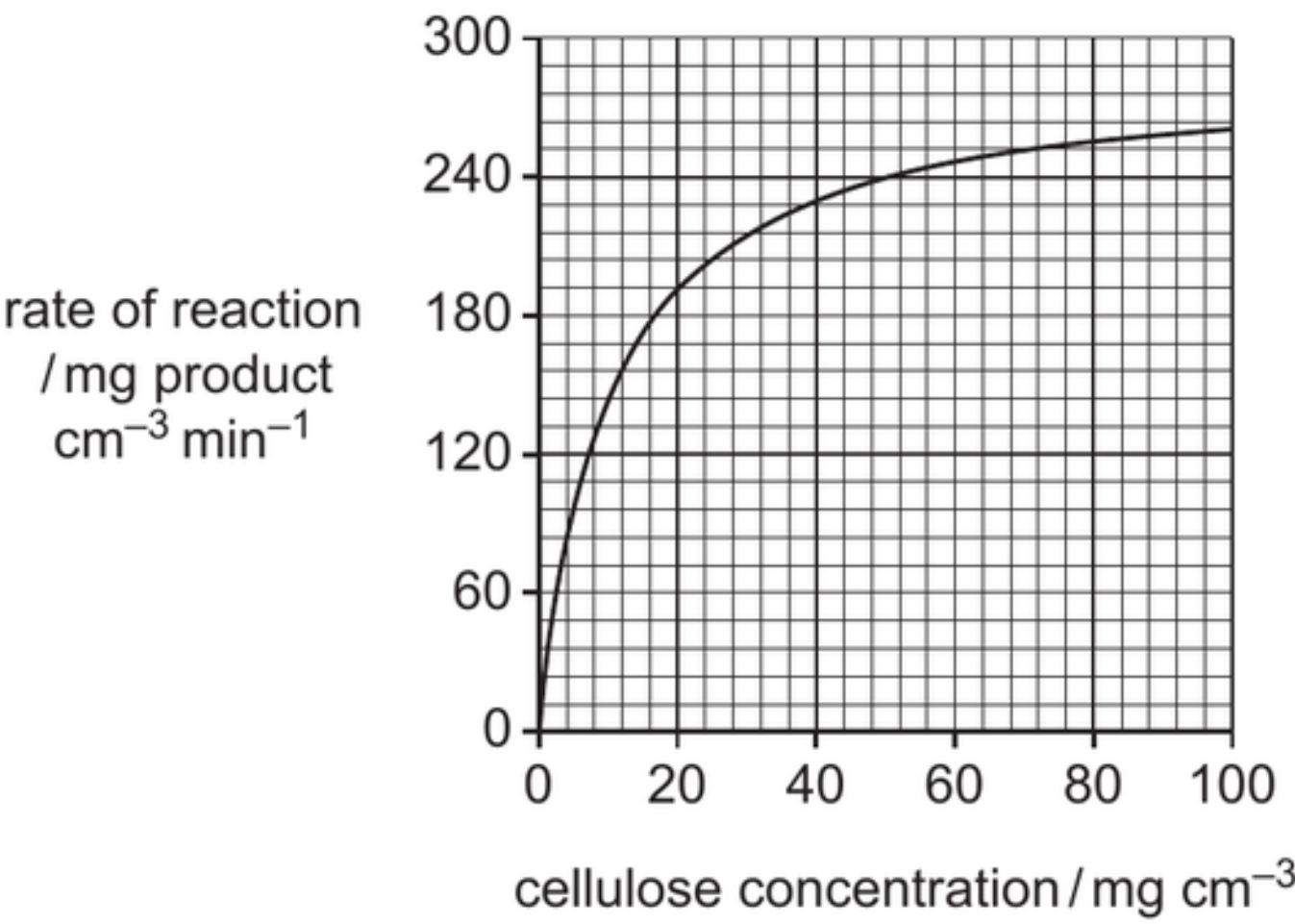


Fig. 5.2

Describe **and** explain the curve shown in Fig. 5.2.

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..... [3]

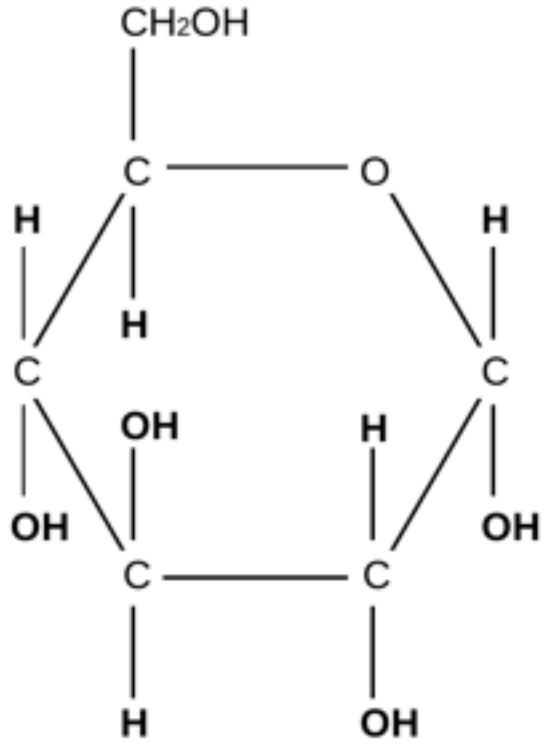
Answer for Question 1 (9700_m25_22_1)

Question	Answer	Marks
1(a)	light / optical (microscope) ;	1
1(b)	460 / 464 (μm) ; A 450–480	1
1(c)	any one from: increase the surface area ; reach a larger volume of, soil / soil particles ; AVP ; e.g. (root hairs) increase the number of aquaporins in cell surface membrane	1
1(d)	max two if answer only refers to either Na^+ or K^+ ions any three from: 1 facilitated diffusion because, higher concentration Na^+ in soil solution / lower concentration Na^+ in root hair cells ; 2 active, transport / uptake, because, higher concentration K^+ in root hair cells / lower concentration K^+ in soil solution ; 3 ions / AW, cannot, diffuse / pass through the, cell (surface) membrane / phospholipid bilayer ; 4 (so) facilitated diffusion uses, channel / carrier proteins or active transport uses carrier proteins ;	3
1(e)	(movement of water) from cell A to cell B by osmosis ; from higher water potential to lower water potential / from less negative ψ to more negative ψ / down the water potential gradient ;	2
1(f)(i)	any four from: 1 (carbon dioxide reacts with water resulting in) carbonic acid produced ; accept from equation 2 carbonic acid dissociates to form, hydrogencarbonate (ions) / HCO_3^-, and, protons / H^+ ; accept from equation accept bicarbonate for hydrogencarbonate 3 pH of soil (solution) lowered / soil (solution) becomes more acidic ; accept correct paired data quotes as alternative to lower pH 4 at lower pH clay particles lose Fe^{2+} / H^+ displaces Fe^{2+} from clay particles ; 5 hydrogencarbonate ions attract (bound) Fe^{2+} into soil solution ; 6 AVP ; e.g. no carbonic anhydrase in soil solution, so reaction slow	4

Answer for Question 1 (9700_m25_22_1)

Question	Answer	Marks
1(f)(ii)	any three from: 1 (Fe²⁺) must cross the cell surface membrane at endodermis / Fe²⁺ moves into, cytoplasm / symplastic route ; 2 due to Casparian strip / impermeability of suberin / AW ; 3 idea that the cell regulates the, quantity / activity, of transport proteins ; 4 metabolised / changed, to insoluble iron compounds (and stored in root) ; 5 transported into / stored in, vacuole of endodermal cell ;	3

Answer for Question 2 (9700_m25_22_2)

Question	Answer	Marks
2(a)	 H and OH correct on C1 ; all other additions complete and correct ;	2
2(b)(i)	C – <u>peptide</u> (bond) ; D – <u>glycosidic</u> (bond) ;	2
2(b)(ii)	act as receptors / bind to ligands, qualified ;	1

Answer for Question 2 (9700_m25_22_2)

Question	Answer	Marks
2(c)	any four from: <i>less organised secondary structure (max three):</i> 1 high proportion of proline so less hydrogen bonding ; 2 so less, alpha helix / beta-pleated sheet, formation ; 3 less opportunity to form hydrogen bonds between –NH of one amino acid and –C=O of another amino acid (close by) ; 4 AVP ; e.g. greater proportion would have a random, coiling / structure ; <i>relatively little tertiary structure (max three):</i> 5 fewer amino acids will be forming ionic bonds between R-groups ; 6 little cysteine so, less / no, disulfide bonding (for tertiary structure) ; 7 (relatively little serine) so less hydrogen, bonding (in tertiary structure) ; 8 AVP ; e.g. high proportion of hydrophobic amino acids (proline and leucine) so tertiary structure will be more dependent on hydrophobic interactions	4

Answer for Question 3 (9700_m24_22_1)

Question	Answer	Marks
1(a)(i)	glycerol ;	1
1(a)(ii)	any one from: hydroxyl / polar, group, interacts with, phosphate heads ; A idea that both are, polar / hydrophilic A hydroxyl group, faces aqueous environment / AW, as it is, polar / hydrophilic non-polar part, in region of / AW, fatty acid tails / AW, as both are, non-polar / hydrophobic ; A non-polar part is hydrophobic so, in centre of membrane / away from aqueous environment	1
1(a)(iii)	any one from: maintains / regulates, fluidity of membrane ; A detail e.g. reduces fluidity at high temperature / increases fluidity at low temperature / AW maintains / regulates, (mechanical) stability of membrane ; AW prevents entry of, hydrophilic substances / polar substances / ions ; without cholesterol membranes would easily rupture flat ring (<i>structure</i>) interferes with the movement of fatty acid tails reduces lateral movement of phospholipids	1
1(b)(i)	sodium ions are (positively charged), so repelled / AW, by the, hydrophobic tails / non-polar core / non-polar tails / AW ;	1

Answer for Question 3 (9700_m24_22_1)

Question	Answer	Marks								
1(b)(ii)	<i>similarity:</i> any one from 1 both occur through / involve, a, membrane / transport, protein ; A carrier protein <i>if context is correct</i> 2 (both can be) specific to the, molecule / ion (passing through) ; A correct ref. to binding site(s) on protein 3 (both involve) conformational change of (carrier) protein) ; R if incorrect context of channel protein AVP ; e.g. can transport substances, into and out of cell / in both directions ; <i>differences:</i> <table><tr><td><i>facilitated diffusion</i></td><td><i>active transport</i></td></tr><tr><td>substances transported down the concentration gradient</td><td>substances transported against a concentration gradient</td></tr><tr><td>passive A does not require, ATP / (metabolic) energy</td><td>requires, ATP / (metabolic) energy</td></tr><tr><td>involves channel and carrier proteins</td><td>does not involve channel proteins / only involves carrier proteins</td></tr></table> <i>If not given as a similarity allow as differences</i> <i>idea that active transport always involves conformational change (facilitated diffusion only carrier protein)</i> <i>idea that active transport always involves specific binding site(s) (facilitated diffusion only with carrier proteins)</i>	<i>facilitated diffusion</i>	<i>active transport</i>	substances transported down the concentration gradient	substances transported against a concentration gradient	passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy	involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins	3
<i>facilitated diffusion</i>	<i>active transport</i>									
substances transported down the concentration gradient	substances transported against a concentration gradient									
passive A does not require, ATP / (metabolic) energy	requires, ATP / (metabolic) energy									
involves channel and carrier proteins	does not involve channel proteins / only involves carrier proteins									
1(c)(i)	any one from: SER (membrane-bound so) can provide, phospholipid / arachidonic acid / substrate ; (prostaglandins are lipids and) SER is involved in lipid transport ; prostaglandins can be transported (from SER) or stored (in SER) ; idea of compartmentalisation / separated from other reactions in the cytoplasm / provides optimum conditions for pathway / higher concentration of enzymes (of pathway) ;	1								

Answer for Question 3 (9700_m24_22_1)

Question	Answer	Marks
1(c)(ii)	any three from: ref. to effect on, ionic bonding / hydrogen bonding / hydrophobic interactions, (with other R-groups) ; changes the, shape / conformation, of the active site ; active site no longer complementary to, arachidonic acid / substrate ; ref. to effect of activation energy not being reduced ; e.g. ref to changed charges (so no electron transfer) no longer provides hydrophobic regions for reaction to occur enzyme–substrate complex, not formed / formed at reduced rate ;	3
1(c)(iii)	any two from: A ligands for prostaglandins <i>if in correct context</i> 1 prostaglandins are, secreted / released, by cells or prostaglandins are, transported / AW, to target cells ; 2 prostaglandins bind to receptors (on target cell surface membranes) ; R antigens 3 example of events triggered leading to a response ; e.g. activation of secondary messenger enzyme, cascade / activation phosphorylation events signal transduction	2

Answer for Question 4 (9700_s24_21_1)

Question	Answer	Marks																				
1(a)(i)	7 <u>nm</u> ; A a suitable range A within the range 5 to 10 <u>nm</u> <i>unit must be shown</i>	1																				
1(a)(ii)	<i>one mark per row – name and letter must agree in row 3 – glycolipid and glycoprotein</i> <i>If no rows are correct or one row is correct, mark by column to give max 2 if one or two columns are correct</i> <table><tr><th>component</th><th>function</th><th>letter on Fig.1.1</th><th></th></tr><tr><td>channel protein</td><td>facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category</td><td>A</td><td>;</td></tr><tr><td>phospholipid</td><td>forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW</td><td>E</td><td>;</td></tr><tr><td>glycoprotein A glycolipid</td><td>receptor for cell signalling</td><td>B D</td><td>;</td></tr><tr><td>cholesterol</td><td>gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity</td><td>F</td><td>;</td></tr></table>	component	function	letter on Fig.1.1		channel protein	facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category	A	;	phospholipid	forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW	E	;	glycoprotein A glycolipid	receptor for cell signalling	B D	;	cholesterol	gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity	F	;	4
component	function	letter on Fig.1.1																				
channel protein	facilitated diffusion or transport of, water / ions / water soluble substances / polar molecules / charged substances / hydrophilic substances I named examples of each category	A	;																			
phospholipid	forms a bilayer or a role within bilayer e.g. barrier to, water soluble / polar substances / ions allows diffusion of, fat soluble / non-polar, substances allows fluidity / provides stability / forms a hydrophobic core / AW	E	;																			
glycoprotein A glycolipid	receptor for cell signalling	B D	;																			
cholesterol	gives (mechanical) stability / maintains fluidity / regulates fluidity / barrier to water soluble substances or at low temperatures, maintains or increases fluidity / prevents close packing A prevents hydrophobic 'tails' interacting at low temperatures or at high temperatures, stabilises the membrane / decreases fluidity	F	;																			

Answer for Question 4 (9700_s24_21_1)

Question	Answer	Marks
1(b)(i)	<i>each organelle must be drawn in the cytoplasm and labelled for a mark</i> <i>max 2 if organelles are drawn correctly but not labelled or are not labelled correctly</i> <i>labels must clearly identify the organelles</i> R any 3D drawings mitochondrion with two membranes and at least one crista ; rough endoplasmic reticulum with at least one cisterna (two lines close together) and ribosomes attached on the outside ; R if any ribosomes completely inside the organelle smooth endoplasmic reticulum with at least one tube with no ribosomes ; A RER and SER as labels A if RER or SER attached to nuclear envelope	3
1(b)(ii)	Golgi body / dictyosome ; A Golgi, apparatus / complex <i>plus any one from:</i> modifies / processes, protein(s) / polypeptide(s) / lipid(s) ; A any suitable type of modification or a description e.g. glycosylation / addition of sugars forming tertiary or quaternary structures packaging of proteins into (Golgi) vesicles ; I transports AVP ; e.g. forming lysosomes / cell wall enzymes assembled	2

Answer for Question 5 (9700_s24_22_2)

Question	Answer	Marks								
2(a)(i)	one mark each correct row <table><tr><th>cell structure</th><th>function</th></tr><tr><td>nucleolus ;</td><td>manufactures ribosomal subunits from proteins and ribosomal RNA</td></tr><tr><td>smooth endoplasmic reticulum ; R endoplasmic</td><td>synthesises triglycerides and other lipids</td></tr><tr><td>pair of centrioles ; R centrosomes</td><td>organise microtubules of the cell cytoskeleton</td></tr></table>	cell structure	function	nucleolus ;	manufactures ribosomal subunits from proteins and ribosomal RNA	smooth endoplasmic reticulum ; R endoplasmic	synthesises triglycerides and other lipids	pair of centrioles ; R centrosomes	organise microtubules of the cell cytoskeleton	3
cell structure	function									
nucleolus ;	manufactures ribosomal subunits from proteins and ribosomal RNA									
smooth endoplasmic reticulum ; R endoplasmic	synthesises triglycerides and other lipids									
pair of centrioles ; R centrosomes	organise microtubules of the cell cytoskeleton									
2(a)(ii)	structures should be labelled and drawn with enough detail not to be mistaken for another structure all three correct = 2 marks one or two correct = 1 mark all three structures correctly drawn but no labels = 1 mark - roughly spherical organelle within the nucleus labelled as nucleolus - minimum of one single membrane-bound tubular sac labelled as, smooth endoplasmic reticulum / smooth ER / SER R if dots (ribosomes) drawn and resembles RER - two, short lines or cylinders, not parallel to each other labelled as (pair of) centrioles R if inside the nucleus	2								

Answer for Question 5 (9700_s24_22_2)

Question	Answer	Marks
2(b)(i)	<i>allow, M. tuberculosis / pathogens / bacteria, for bacterial cells</i> endocytosis occurs / described ; e.g. (macrophage cell surface) membrane, surrounds / AW, bacterial cells pseudopodia, surrounds / form round / AW, bacterial cell (alveolar) macrophage / phagocyte / (phagocytic) cell, envelops / engulfs, bacterial cells ; event occurring before <u>or</u> after ; <i>e.g. before</i> <i>ref. to</i> chemotaxis / chemotactic response bacterial cells / bacteria / (bacterial) antigens, bind / attach / join / AW, to (macrophage cell surface), receptors / membrane I binding to, macrophage / cell <i>suggestion of</i> (in alveolar space) opsonisation of /antibody binding to, bacterial cells <i>e.g. after</i> membrane fusion / (phagocytic), vacuole pinches off / AW A vesicle for vacuole	2
2(b)(ii)	lysosomes / lysosome ; A lysosomal vesicles	1

Answer for Question 5 (9700_s24_22_2)

Question	Answer	Marks
2(c)	any four from: 1 cells are replicating / AW (because live vaccine) ; 2 high / increased / AW, levels of (non-self / foreign) antigen (because live vaccine) ; 3 (so) strong / effective / good / AW, (primary) <u>immune response</u> ; A described e.g. (T-/B-) memory cells are formed <i>idea that</i> memory cells present when <i>Mycobacterium</i> infects / AW secondary response occurs when <i>Mycobacterium</i> infects / AW 4 provides (artificial) active immunity ; R natural active immunity 5 (so) boosters not needed (to build sufficient immunity) ; 6 vaccine does not cause, disease / TB (because, weakened / attenuated) ; I doesn't show symptoms 7 easy to, transport / store / deliver (because freeze-dried) ; 8 AVP ;; e.g. effective against <i>M. tuberculosis</i> and <i>M. bovis</i> no / few / mild, side effects, so people not discouraged (from having vaccine) memory cells / immunity, (relatively) long-lived / long-lasting only need one dose (good immunity for most individuals) provides herd immunity (<i>a consequential effect</i>)	4

Answer for Question 6 (9700_s24_22_4)

Question	Answer	Marks
4(a)	<i>allow points from correctly labelled diagram</i> (monomers of) beta-glucose / β-glucose ; R α-glucose / two β-glucoses <i>plus any two from:</i> <i>max 1 if no monomer stated</i> (joined by) 1, 4 glycosidic bonds ; A 1,4 glycosidic bonds R 1,4 <u>and</u> 1,6 bonds each (β-) glucose rotated by 180° compared to adjacent (β-)glucose ; AW linear / straight, chain / molecule; unbranched ;	3
4(b)(i)	<i>any one from:</i> increases rate of translation of, enzyme / nitrate reductase ; increases, enzyme / nitrate reductase, synthesis / concentration ; A more nitrate reductase produced <i>idea of</i> more metabolically efficient ; e.g. enzyme only produced when needed AVP ; e.g. more nitrate is reduced to nitrite / more nitrite is formed leads to increased supply of nitrite for amino acids / amino acid synthesis	1

Answer for Question 6 (9700_s24_22_4)

Question	Answer	Marks
4(b)(ii)	<i>any two from:</i> improves accuracy of results / results not by eye / results not subjective ; A detects smallest change in, (intensity of) colour / concentration / quantity provides quantitative results / obtain numerical values ; A described e.g. absorbance values / can measure absorbance/ gives percentage transmission / absorbance readings <i>idea that</i> different, intensities / shades of, colour / magenta / red-purple, relate to different, quantities / concentrations, of nitrites ; A relate to (rates of) nitrate uptake can produce calibration curve (for quantitative results) ; AVP ; e.g. can detect, (very) low concentrations / faintly coloured samples	2

Answer for Question 6 (9700_s24_22_4)

Question	Answer	Marks
4(c)(i)	<i>accept hydrogen ions / H⁺, for protons</i> <i>max 3 if no ref. to amino acids</i> <i>any four from:</i> 1 protons, moved by active transport / pumped, out of (companion) cell ; A using, energy / ATP <i>for active transport</i> 2 protons, moved into / enter / AW, cell wall / apoplast ; R if moved out to phloem sieve tube 3 proton gradient builds up in, apoplast / cell wall ; A higher concentration A high concentration if mp4 gained 4 protons move back (into companion cell), by facilitated diffusion / AW ; e.g. down, electrochemical / concentration, gradient from high(er) to low(er) concentration A diffuse <i>if movement is described through a transport protein in mp5</i> 5 protons cotransport amino acids or amino acids move with protons through, a cotransporter / a cotransport protein / (amino acid) transporter ; 6 amino acids, transported / AW, against their concentration gradient ;	4
4(c)(ii)	plasmodesmata present ; A movement is down the, concentration / diffusion, gradient A because there is a high(er) concentration in the companion cell ora for phloem sieve tube (sap)	1

Answer for Question 6 (9700_s24_22_4)

Question	Answer	Marks										
4(d)	0.2 mmol dm⁻³ constant rate v 5.0 mmol dm⁻³, rate not constant / described ; 0.2 mmol dm⁻³ lower rate than 5.0 mmol dm⁻³ ; ora 5.0 mmol dm⁻³ higher rate A faster / slower, rate for higher / lower, rate A (overall) steeper rate / less steep rate calculated rates to support ;	2										
4(e)	any four from: 1 (experiments suggest mainly) active transport / active uptake ; A uptake, is an active process / needs energy / needs ATP <i>if mp8 given, allow 'active transport and facilitated diffusion'</i> 2 comparison of experiments with control, any one ; <table><tr><th>expt</th><th>discussion point</th></tr><tr><td>1</td><td>oxygen required for (complete) uptake A aeration required or almost no /AW, uptake, with no oxygen / in anaerobic conditions</td></tr><tr><td>2</td><td>almost no / AW, uptake, in, low temperature / at 3°C or uptake, higher / AW, at 30°C / in control</td></tr><tr><td>3</td><td>proteins / enzymes, are, required for / involved in, uptake or (much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present</td></tr><tr><td>4</td><td>slightly lower / very similar, uptake / AW, without any bacteria or slightly higher / very similar, uptake / AW, with bacteria (control)</td></tr></table> 3 one comparative result / manipulated data, with units, to support mp2 ;	expt	discussion point	1	oxygen required for (complete) uptake A aeration required or almost no /AW, uptake, with no oxygen / in anaerobic conditions	2	almost no / AW, uptake, in, low temperature / at 3°C or uptake, higher / AW, at 30°C / in control	3	proteins / enzymes, are, required for / involved in, uptake or (much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present	4	slightly lower / very similar, uptake / AW, without any bacteria or slightly higher / very similar, uptake / AW, with bacteria (control)	4
expt	discussion point											
1	oxygen required for (complete) uptake A aeration required or almost no /AW, uptake, with no oxygen / in anaerobic conditions											
2	almost no / AW, uptake, in, low temperature / at 3°C or uptake, higher / AW, at 30°C / in control											
3	proteins / enzymes, are, required for / involved in, uptake or (much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present											
4	slightly lower / very similar, uptake / AW, without any bacteria or slightly higher / very similar, uptake / AW, with bacteria (control)											

Answer for Question 6 (9700_s24_22_4)

Question	Answer					Marks	
4(e)	experiment	experiment v control	or	lower by	only needs to state control value once somewhere in response		
	1	0.4 v 10.9 μmol g ⁻¹		10.5 μmol g ⁻¹			
	2	0.6 v 10.9 μmol g ⁻¹		10.3 μmol g ⁻¹			
	3	1.4 v 10.9 μmol g ⁻¹		9.5 μmol g ⁻¹			
	4	10.0 v 10.9 μmol g ⁻¹		0.9 μmol g ⁻¹			
	discussion points						
	4 aerobic respiration needs oxygen ;						
	5 lower temperature means lower activity of enzymes involved in respiration ;						
	6 ref. to ATP (for active transport) ; e.g. (aerobic) respiration produces ATP less respiration means less ATP produced no ATP for, conformational change / AW (of carrier protein)						
	7 some (facilitated) diffusion because some uptake without oxygen ;						
	8 protein synthesis needed for transport proteins ; A membrane / transport / carrier / channel, proteins not being synthesised A no protein synthesis so less ATP synthase						
	9 effect of lower temperature on transport ; ora for control e.g. reduces rate of (facilitated) diffusion affects, ATPase / carrier protein, for active transport transport proteins less efficient at low temperature						
	10 bacteria will have, little / no, effect on uptake or (normally) bacteria (associated with roots), increase / help, nitrate uptake ;						
	11 AVP ; e.g. idea that nitrate uptake involves metabolic processes						

Answer for Question 7 (9700_w24_22_6)

Question	Answer	Marks
6(a)	any four from: - cell wall, pathway / route / AW ; R crossing membranes / passing through vacuoles / passing through cytoplasm, <i>in context of passage to endodermis</i> I diffuses / osmosis / active transport - movement (also), through intercellular spaces / in spaces between cells ; R intracellular spaces - named cell layer in <u>apoplast</u> pathway to endodermis ; e.g. epidermal cells / root hair cells cells of cortex / cortical cells / parenchyma cells <i>must be in context of cell walls</i> - cannot cross / stops at, Casparian strip (of endodermal cells) ; - detail ; made of, suberin or described as a, waxy / waterproof / impermeable (layer / substance / material in cell walls) (overall) movement down a water potential gradient ; R ref. to osmosis / active transport <i>context of across root or from root to xylem (owing to overall root to, leaf / atmosphere, gradient)</i> - AVP ; e.g. non-living pathway / does not cross membranes, until the endodermis idea that water needs to pass across a cell (surface) membrane to control substances entering xylem	4

Answer for Question 7 (9700_w24_22_6)

Question	Answer				Marks
6(b)	net movement of K ⁺	membrane protein needed (yes or no)	ATP used (yes or no)	name of transport mechanism	3
	against the concentration gradient	yes	yes	active, transport / uptake	
	down the concentration gradient	yes	no	facilitated diffusion	
	one mark each correct column ;;;				
	if no marks gained, allow one mark for a correct row				

Answer for Question 8 (9700_w24_22_1)

Question	Answer	Marks								
1(a)(i)	<i>all correct for one mark ;</i> <table><tr><td>palmitic acid</td><td>0</td></tr><tr><td>linoleic acid</td><td>2</td></tr><tr><td>stearic acid</td><td>0</td></tr><tr><td>palmitoleic acid</td><td>1</td></tr></table>	palmitic acid	0	linoleic acid	2	stearic acid	0	palmitoleic acid	1	1
palmitic acid	0									
linoleic acid	2									
stearic acid	0									
palmitoleic acid	1									
1(a)(ii)	circle drawn around palmitic acid <u>and</u> around stearic acid ;	1								
1(a)(iii)	COOH / carboxyl (group) / carboxylic acid (group) ; A carbonyl group and hydroxyl group R if response includes incorrect groups	1								

Answer for Question 8 (9700_w24_22_1)

Question	Answer	Marks
1(a)(iv)	<i>if no ref. to fatty acids, allow one mark for (some) triglycerides may, be saturated / have no double bonds (in hydrocarbon chain,) <u>and</u> (some) may, be unsaturated / have double bonds</i> I 'tails' any two from: 1 each triglyceride has three fatty acids ; 2 fatty acids can be, <u>saturated</u> / with no double bonds, <u>and</u>, <u>unsaturated</u> / with double bonds ; A unsaturated fatty acids can have a different number of double bonds 3 fatty acids can have different, (hydrocarbon chain) lengths / number of carbons ; 4 detail from Table 1.1 to support mp2 or 3 ; saturated = palmitic / stearic v unsaturated = oleic / linoleic / palmitoleic or 1 double bond = oleic / palmitoleic v 2 double bonds = linoleic or oleic / linoleic / stearic = 18C v palmitic / palmitoleic = 16C 5 <i>idea of</i> a particular fatty acid, can be located at a different position in a triglyceride / can form a bond with any one of the three (functional) hydroxyl groups ; 6 <i>ref. to</i> different environmental conditions of plants grown in different regions ; e.g. colder conditions and oils having (more triglycerides with) higher proportion of unsaturated fatty acids 7 <i>idea of</i> (shared triglycerides) have structures (most) suited as energy stores ; A example e.g. (have fatty acids with) longest hydrocarbon chains easiest to, hydrolyse / release hydrogen atoms have greater energy value than others 8 <i>ref. to</i> ease of, production / synthesis ; 9 <i>idea that</i> shared triglycerides composed of the fatty acids (present) in highest proportions ; e.g. <i>using Table 1.1 to determine the most common 2 or 3 fatty acids</i> 'could all have the same fatty acid combination from oleic acid and / or palmitic acid and/or linoleic acid' (any two)	2

Answer for Question 8 (9700_w24_22_1)

Question	Answer	Marks
1(b)	any two from: 1 water is, a polar molecule / polar / dipolar ; A water is a dipole A description e.g. the O atom (of water) has, a slightly negative / δ^-, charge, <u>and</u> the H atoms have a slightly positive / δ^+, charge 2 water can form, hydrogen bonds / H-bonds, with, glycerol / polar substances ; ora = water cannot form H-bonds with, triglycerides / non-polar substances 3 glycerol / polar molecules / ions, <u>interact</u> with water (molecules) / are attracted to water (molecules) / are hydrophilic ; A idea that water, attracts / collects around / AW, ions / charged substances ora = triglycerides / non-polar / uncharged, molecules, do not interact with water / repel water / are hydrophobic I 'tails'	2
1(c)	(phloem) <u>sieve tube element</u> ; (<i>question asks for type of cell</i>) A sieve element	1

Answer for Question 9 (9700_m23_22_1)

Question	Answer	Marks															
1(a)	<table border="1"> <thead> <tr> <th>cell structure</th><th>eukaryotic cells</th><th>prokaryotic cells</th></tr> </thead> <tbody> <tr> <td>nucleus</td><td>✓</td><td>✗</td></tr> <tr> <td>Golgi body</td><td>✓</td><td>✗</td></tr> <tr> <td>circular DNA</td><td>✓</td><td>✓</td></tr> <tr> <td>70S ribosome</td><td>✓</td><td>✓</td></tr> </tbody> </table> one mark for each correct column ; ;	cell structure	eukaryotic cells	prokaryotic cells	nucleus	✓	✗	Golgi body	✓	✗	circular DNA	✓	✓	70S ribosome	✓	✓	2
cell structure	eukaryotic cells	prokaryotic cells															
nucleus	✓	✗															
Golgi body	✓	✗															
circular DNA	✓	✓															
70S ribosome	✓	✓															
1(b)	<i>diagram showing:</i> dark line(s) labelled as phosphate heads ; A phospholipid heads clear area(s) between pairs of dark lines labelled as, fatty acid tails / hydrocarbon chains / hydrophobic core / AW ; R if pointing to intercellular space clear area between the two cell surface membranes labelled as, interstitial fluid / tissue fluid / extracellular matrix / intercellular space ; A intercellular, area / region	3															

Answer for Question 9 (9700_m23_22_1)

Question	Answer	Marks
1(c)(i)	<i>G₁ phase:</i> <i>any one from:</i> RNA, synthesised / transcribed / translated ; proteins / enzymes, synthesised ; increasing quantity of organelles ; increase in volume of cytoplasm ; A growth (at end of <i>G₁</i> phase) checkpoint passed for dividing or not ; <i>S phase:</i> <i>any one from:</i> DNA (semi-conservative) replication ; doubles, mass / number of strands, of DNA ; ref. to each chromosome now comprises two chromatids ;	2
1(c)(ii)	<i>any one from:</i> uncontrolled / increased, cell division / mitosis ; resting cells could enter mitosis ; more cells move from the <i>G₁</i> to the S phase ;	1

Answer for Question 10 (9700_s23_21_3)

Question	Answer	Marks
3(a)	polar / water soluble / hydrophilic, substances cannot pass through the, phospholipid bilayer / hydrophobic core (in cell surface membranes) ; I too large / active transport / facilitated diffusion / (hydrophobic) fatty acid 'tails'	1
3(b)(i)	rate of uptake, becomes constant / reaches a plateau or at <u>high</u> concentrations / concentrations of $> 150 \mu\text{mol dm}^{-3}$, rate of uptake remains constant ; A levels off protein carriers / (hexose) transporters / VvHT1s, are working at their highest rate / are saturated ; A the number of protein carriers is limiting factor / AW A V_{max} is reached <i>in context of transporters</i>	2

Question	Answer	Marks
3(b)(ii)	<i>any two from:</i> I size / quality of grapes / grapevines 1 grapes will, be sweeter / have improved taste ; 2 <i>idea that</i> concentration of sugars in grapes determines uptake of water by osmosis ; 3 <i>idea of</i> more energy for growth of the grapes ; 4 larger yield ; 5 increased, profit / income, for farmers ; 6 AVP ; e.g. producing grapes in shorter time	2
3(c)(i)	(foreign) protein / glycoprotein, that stimulates, an immune response / production of antibodies / activation of lymphocytes ; A polysaccharide / molecule / foreign substance / foreign antigen	1

Answer for Question 10 (9700_s23_21_3)

Question	Answer	Marks
3(c)(ii)	<i>any four from:</i> <i>accept T-cells for T-lymphocytes</i> 1 (group / clone of) T-lymphocytes have receptors <u>complementary</u> to an antigen ; A <u>specific</u> T-lymphocytes have receptors to an antigen 2 (specific) T-lymphocytes, bind / AW, to antigen (on surface of antigen-presenting cell / macrophage) ; 3 (selected) T-lymphocytes, divide many times (by mitosis) / undergo clonal expansion ; 4 T-helper cells secrete, cytokines / interleukins / interferon ; 5 detail of effect of cytokine ; e.g. activation of B-lymphocytes / increased phagocytosis by macrophages / 'angry' macrophages 6 T-killer cells, bind / attach, to infected cells and destroy them ; 7 detail of action of T-killer cells ; e.g. <i>ref. to</i>, perforin / granzyme / hydrogen peroxide / toxins 8 production of memory cells (in context of T-lymphocytes / T-helper cells / T-killer cells) ;	4

Answer for Question 11 (9700_s23_23_6)

Question	Answer	Marks
6(a)	any three from: nystose is not branched / glycogen is branched ; different glycosidic bonds, qualified ; e.g. nystose has one type of glycosidic bond <u>and</u> glycogen has two types 1-4 <u>and</u> 1-6 (glycosidic) bonds in glycogen (v 1-2 glycosidic bonds in nystose) two types of monomer / AW, in nystose v only glucose in glycogen ; nystose contains one glucose (residue / monomer) ; ref. to ring shape, glycogen monomers have six-sided rings <u>and</u> nystose has (a) six-sided ring and five-sided rings ; AVP ; e.g. fructose in nystose <u>and</u> no fructose in glycogen I numbers of C,H and O	3

Answer for Question 11 (9700_s23_23_6)

Question	Answer	Marks
6(b)	<i>any four from:</i> <i>must attempt both to gain max 4</i> <i>rough endoplasmic reticulum</i> translation (of mRNA) / polypeptide synthesis, at ribosomes ; A protein synthesis polypeptide folding (in lumen) ; A protein folding packaged in / formation of, transport vesicles / vesicles for transport, to Golgi body ; <i>Golgi body</i> packaging into, Golgi / secretory, vesicles ; A formation of, Golgi / secretory vesicle, containing glycoprotein A packaging into vesicles for transport to cell surface membrane <i>rough endoplasmic reticulum or Golgi body</i> (modification by) glycosylation (of protein) / described ; e.g attachment of, sugars / oligosaccharide / polysaccharide / carbohydrate <i>ref. to checking for, misfolded / incorrectly synthesised, proteins ;</i> additional detail of post-translational modification ; e.g. <i>suggestion of</i> forming quaternary structure addition of non-protein groups	4

Answer for Question 11 (9700_s23_23_6)

Question	Answer	Marks
6(c)	<i>any one from:</i> cell signalling or receptor(s) / binding site(s) , for , chemicals / hormones / molecules ; cell recognition or (cell surface) antigens or cell-cell interactions ;	1

Answer for Question 12 (9700_w23_21_1)

Question	Answer	Marks
1(a)(i)	any three from: active transport ; A active uptake against the concentration gradient ; A use of values to support using, energy / ATP ; conformational change / described (of protein carrier) ; ref. to specific binding site ;	3
1(a)(ii)	similarity max 1 ref. to diffusion / (movement) down concentration gradient ; passive or no, energy / ATP, required ; difference max 1 sodium ions enter by facilitated diffusion <u>and</u> oxygen molecules enter by (simple) diffusion ; A passive diffusion sodium ions, use a carrier / channel / transport, protein ; or sodium ions do not, pass through the phospholipid bilayer / cross the hydrophobic core (of the bilayer) ; A ora for oxygen	2

Answer for Question 12 (9700_w23_21_1)

Question	Answer	Marks
1(a)(iii)	any two from: hydrogen carbonate ions move out of red blood cells (to be transported in plasma), so / and, chloride ions move in ; to maintain electrical neutrality (inside, cytoplasm / cell) ; A balance the charges (either side of membrane) A to prevent build-up of negative charge (in cytoplasm) AVP ; e.g. maintain equilibrium to increase reaction between carbon dioxide and water	2
1(b)	endocytosis / pinocytosis ; A bulk transport	1

Answer for Question 13 (9700_w23_21_4)

Question	Answer	Marks
4(a)(i)	human immunodeficiency virus ;	1
4(a)(ii)	any four from: there is a decrease in the percentage infections in most regions / AW ; ref. to exceptions to this decreasing trend ; e.g. B (Eastern Europe and Central Asia) / D (Middle East and North Africa) <i>allow no overall trend if mp 1 and mp 2 not awarded</i> the biggest percentage decrease, in E (East and Southern Africa) ; the smallest percentage decrease, in G (Latin America) ; data quote to support described trend ; AVP ;	4

Answer for Question 13 (9700_w23_21_4)

Question	Answer	Marks
4(b)	any four from: tuberculosis / TB, is an opportunistic, disease / infection ; weakened immune system ; (fewer T-helper cells so a) less effective primary immune response ; (fewer helper T-cells so) less cytokine secreted ; less, phagocytosis of the pathogens / AW ; A ref. to angry macrophages fewer B-lymphocytes, stimulated / AW, to divide by mitosis and form plasma cells ; fewer antibodies secreted so fewer pathogens destroyed ; ref. to latent TB becoming activated ; AVP ; e.g. 'weak' / no, response to (BCG) vaccine so, fewer / no, memory cells TB is caused by, a bacterial pathogen / <i>Mycobacterium tuberculosis</i> / <i>Mycobacterium bovis</i>	4

Answer for Question 13 (9700_w23_21_4)

Question	Answer	Marks
4(c)	any four from: 1 ref. to compression on ventricles ; 2 (so) volume of the ventricles reduces / ventricles cannot fully increase in size / AW ; 3 less blood, filling / leaving, ventricles (each cardiac cycle) ; 4 <i>idea that</i> ventricular, contraction / systole, less powerful / weaker / less forceful ; 5 less blood pumped to the, pulmonary / systemic, circulation (per, contraction / cardiac cycle / unit time ; A lungs / rest of body <i>faster breathing rate to compensate for</i> 6 consequence in, lungs / rest of body ; e.g. less oxygen, diffuses / AW, into the blood less carbon dioxide, diffuses / AW, out of the blood less oxygen delivered to the tissues / AW 7 faster breathing rate to (try and) increase quantity of oxygen, absorbed / AW (in the lungs) ; A increase quantity of carbon dioxide excreted 8 AVP ; e.g. heart / cardiac muscle, does not receive enough, glucose / oxygen	4

Answer for Question 14 (9700_w23_21_3)

Question	Answer	Marks
3(a)	(cell type A) phloem sieve tube element ; <i>plus any two from:</i> connect the cytoplasm of the two cells / <i>ref. to</i> the symplast pathway ; <i>idea of</i> allow (rapid) diffusion of, sucrose / named molecules, from one cell to an adjacent cell / AW ; <i>idea of</i> efficiency of, loading into / unloading from, sieve tubes ;	3

Answer for Question 14 (9700_w23_21_3)

Question	Answer	Marks															
3(b)	<table border="1"> <thead> <tr> <th>feature of polysaccharide</th><th>callose molecule</th><th>cellulose molecule</th></tr> </thead> <tbody> <tr> <td>monosaccharide used to synthesise the polysaccharide</td><td></td><td>beta / β, glucose ; R B glucose</td></tr> <tr> <td>bond connecting the monomers</td><td>1, 3 glycosidic bond ;</td><td></td></tr> <tr> <td>shape of molecule</td><td></td><td>straight / linear ;</td></tr> <tr> <td>orientation of monosaccharides in the molecule</td><td>adjacent glucose molecules same way up / AW ;</td><td></td></tr> </tbody> </table>	feature of polysaccharide	callose molecule	cellulose molecule	monosaccharide used to synthesise the polysaccharide		beta / β , glucose ; R B glucose	bond connecting the monomers	1, 3 glycosidic bond ;		shape of molecule		straight / linear ;	orientation of monosaccharides in the molecule	adjacent glucose molecules same way up / AW ;		4
feature of polysaccharide	callose molecule	cellulose molecule															
monosaccharide used to synthesise the polysaccharide		beta / β , glucose ; R B glucose															
bond connecting the monomers	1, 3 glycosidic bond ;																
shape of molecule		straight / linear ;															
orientation of monosaccharides in the molecule	adjacent glucose molecules same way up / AW ;																
3(c)	any three from: (hydrogen bonding) gives adhesion between water molecules and, cellulose / hydrophilic parts of lignin (in xylem wall) ; (hydrogen bonding) gives cohesion between water molecules ; formation of continuous column / AW ; A adhesion, prevents column of water collapsing / AW transpiration pull ; A water, drawn up / pulled up by transpiration / pulled up by evaporation detail ; e.g. water evaporating from spongy mesophyll surfaces water vapour lost from, leaf / plant, during transpiration <i>idea of</i> creates tension AVP ; <i>if mp 1 and mp 2 are not awarded, allow one mark for reference to cohesion <u>and</u> adhesion</i>	3															

Answer for Question 14 (9700_w23_21_3)

Question	Answer	Marks
3(d)	<i>any two from:</i> hydrogen bonds between water molecules must break for water, to change state / evaporate / AW ; loss of, heat / energy for, evaporation / transpiration (will cool the, leaf / plant) ;	2

Answer for Question 15 (9700_w23_22_3)

Question	Answer	Marks
3(a)	<u>aorta</u> / dorsal aorta ; <i>correct spelling needed</i>	1
3(b)(i)	any one from: <i>context is using gaps for movement between, hepatocyte / tissue fluid, and, blood / sinusoid</i> I ref. to red blood cells I shorter diffusion, distance / pathway higher rate of / easier for / AW, exchange / movement / AW, of substances ; A named substances / nutrients substances do not have to cross, a cell layer / into and out of endothelial cells ; larger molecules / plasma proteins, can pass through ; Kupffer cells can pass through (into tissue fluid) ; AW A ref. to other phagocytic cells R Kupffer cells can diffuse through R if stated as entering hepatocytes	1

Answer for Question 15 (9700_w23_22_3)

Question	Answer	Marks
3(b)(ii)	<i>max 3 if described as phagocytosis of a pathogen rather than a red blood cell</i> <i>allow rbc for red blood cell</i> <i>any four from:</i> 1 endocytosis / phagocytosis ; 2 described ; e.g. red blood cell, engulfed / enveloped pseudopodia surround red blood cell <i>max three from</i> 3 forms (phagocytic) vacuole / (phagocytic) vesicle / phagosome ; 4 lysosome fuses (with phagosome) ; AW merges / joins to / combines with I attaches / binds to 5 (lysosome contains) hydrolytic / digestive, enzymes ; A hydrolases / named examples 6 digestion to produce haem and globin ; A amino acids for globin 7 AVP ; e.g. suggestion of, detection / recognition, of red blood cell	4

Answer for Question 15 (9700_w23_22_3)

Question	Answer	Marks
3(c)(i)	<i>any three from:</i> I Golgi body / lysosome / vesicle <i>mp1 <u>and</u> mp2 complete term needed either in the text or labelled</i> 1 <u>smooth endoplasmic reticulum</u> labelled on Fig. 3.2 and detail ; e.g. for, lipid / triglyceride / cholesterol, synthesis tubular appearance / no ribosomes 2 <u>rough endoplasmic reticulum</u> labelled on Fig. 3.2 and detail ; e.g. for protein, synthesis / AW A for enzyme synthesis flattened (sac) appearance ribosomes A ribosome(s) labelled <u>and</u> for (plasma) protein synthesis 3 mitochondrion labelled on Fig. 3.2 <u>and</u> detail ; e.g. many mitochondria for (aerobic) respiration produce ATP / provide energy, (for hepatocyte reactions) R generate / make, energy double membrane / presence of cristae <i>allow if one mitochondrion is correctly labelled and one of the 'circular' mitochondria has a different label e.g lysosome</i> 4 presence of glycogen granule(s) as, energy / glucose, store ; A releases / provides, glucose 5 presence of lipid droplet(s), as energy store ; A provides fatty acids A provides components for cholesterol synthesis <i>penalise once (from mp1, 2, or 3) if diagram not labelled but structures named correctly and correct detail given</i>	

Answer for Question 15 (9700_w23_22_3)

Question	Answer	Marks
3(c)(ii)	any one from: I ref. to staining or size mitochondrion, bound by / has, double membrane / two membranes ; I peroxisome has (only) one membrane peroxisome no cristae / mitochondrion has cristae ; R cisternae peroxisome spherical shape <u>and</u> mitochondria, different shapes / AW ; I if only peroxisome shape stated A circular for spherical A description e.g. 'sausage' shape	1
3(c)(iii)	any two from: mitochondrion (ora for peroxisomes) has, DNA / genes (coding for enzymes) ; R linear DNA A genetic, material / information, qualified with, transcription / ref. to mRNA / coding for enzymes (70S) ribosomes (site of enzyme synthesis) ; R 80S ribosomes has the enzymes for, transcription / translation, (to synthesise enzymes) ; can produce ATP (for enzyme synthesis) ; R produce energy I has ATP AVP ; ; other suggestions e.g. has (chaperone) proteins involved in, folding / formation of tertiary structure ATP cannot enter peroxisome to provide energy source peroxisome has enzymes that cause degradation of, one / or more, substance(s) involved in protein synthesis	2

Answer for Question 15 (9700_w23_22_3)

Question	Answer	Marks
3(c)(iv)	any two from: (peroxisome) membrane bound, so rest of cell protected (from hydrogen peroxide) ; A hydrogen peroxide can have toxic effects on (rest of) cell / AW (peroxisome) acts as a compartment / specific area / contained, for, more efficient breakdown of hydrogen peroxide / control of reactions ; high concentration of enzyme in one location ; A more enzyme-substrate complexes can form provides, optimum / AW, conditions, for (other peroxisome) reactions ; production of oxygen as by-product, so useful for, peroxisome reactions requiring oxygen / mitochondrial function / aerobic respiration ; AVP ; e.g. isolates (peroxisomes) enzymes from rest of cell	2

Answer for Question 16 (9700_w23_23_4)

Question	Answer	Marks
4(a)(i)	RNA polymerase ;	1
4(a)(ii)	phosphodiester ;	1
4(b)(i)	5 ;	1
4(b)(ii)	any two from: 1 other strand is not the <u>template</u> strand / only the <u>template</u> strand is transcribed ; 2 (if transcribed) sequence of, nucleotides / bases, in (m)RNA codes for a different sequence of amino acids ; A sequence of codons A primary transcript for RNA 3 (if transcribed) results in a non-functional polypeptide / AW ; A codes for a polypeptide with different function 4 translation would be a waste of energy / translation will not occur (as no signalling sequence) ; 5 any suggestion of a possible consequence to structure of collagen ; 6 (m)RNA is single stranded ; 7 AVP ; e.g. RNA polymerase synthesises RNA in the 5' to 3' direction	2
4(c)(i)	ref. to (mitochondrial) envelope / two membranes / double membrane / inner membrane and outer membrane ; R cell or cell surface membrane inner membrane is folded / crista(e) ; (70S) ribosomes ; R 80S ribosomes (mitochondrial) matrix ; I DNA	2
4(c)(ii)	0.6 (μm) ; R 0.60 (only one significant figure required)	1

Answer for Question 16 (9700_w23_23_4)

Question	Answer	Marks
4(d)	any three from: 1 active transport, uses ATP / moves (ions) against concentration gradient ; 2 facilitated diffusion, passive / no ATP / no energy / with the gradient / down concentration gradient ; 3 protein, carrier / pump, changes shape / <i>ref. to</i> conformation change / has binding site(s) ; 4 channel protein / pore protein, for facilitated diffusion (only) ; I carrier protein 5 AVP ; e.g. <i>ref. to</i> ionophore(s) / hydrophilic pore in channel proteins / specificity of carrier or channel protein(s) <i>if mp1 and mp2 are not awarded allow one mark for naming active transport <u>and</u> facilitated diffusion</i>	3

Answer for Question 17 (9700_m22_22_1)

Question	Answer	Marks
1(a)	<i>assume in context of transmission electron micrograph unless otherwise stated</i> any one from: <i>idea that can see internal structures ;</i> <i>cannot see surface contours / AW ;</i> A not 3-D appearance AVP ; e.g. ref. to small(er) depth of field ;	1
1(b)	any two from: (flattened) sacs have layered appearance / no connection between membranes / AW / ora ; not, connected to / contiguous with / continuous with, (outer membrane of) nuclear envelope / ora ; swellings at end of sacs (for vesicle formation) / vesicles at ends of sacs ; no ribosomes / ora ;	2
1(c)	actual diameter = image length / magnification ; <i>at 11 mm for X–Y:</i> 234 nm ; A 213 nm (for 10 mm) A 255 nm (for 12 mm) A 223 nm (for 10.5 mm) A 245 nm (for 11.5 mm)	2

Answer for Question 17 (9700_m22_22_1)

Question	Answer	Marks
1(d)(i)	1 glycocalyx 1 glyco / carbohydrate chains A points from labelled diagram 1 phospholipid <u>bilayer</u> ; <i>plus any two from:</i> 2 fatty acid core / fatty acid tails orientated inwards ; 3 protein ; 4 further detail of proteins ; e.g. integral and peripheral / AW scattered (in phospholipid bilayer) 5 cholesterol ;	3
1(d)(ii)	<i>any one relevant suggestion:</i> reduced gaps between membrane molecules ; higher proportion of phospholipids with saturated fatty acids / ora ; fewer unsaturated fatty acids so, fewer 'kinks' in tails / closer packing ; higher proportion of cholesterol molecules ; fewer, channel / carrier / transport, proteins ; smaller diameter of channels in non-specific channel proteins ; fewer types of (specific), transport / carrier, proteins ; AVP ; e.g. fewer, aquaporins / channels for water	1

Answer for Question 18 (9700_s22_22_1)

Question	Answer	Marks
1(a)	I ref. to resolution any one from: Fig. 1.1A is scanning (EM), qualified ; e.g. shows, surface / contour / 3-D, views shows (only the), the outer / external, view (of microvilli) idea of good focus with different depths does not have stated feature of TEM (see mp2) Fig. 1.1B is transmission (EM), qualified ; e.g. showing, 2D / flat, views (of, microvilli / mitochondria) image in one plane showing section through, mitochondria / microvilli / cell I thin shows, internal view of cell / contents of cell / AW does not have stated feature of SEM (see mp1) scanning (EM) stated plus feature and transmission (EM) stated plus feature } ; if Fig. 1.1, A / B not identified	1
1(b)	any two from: max 1 if stating to measure one of the sides of the figure (for each image) measure a number of microvilli and calculate a mean ; same units for actual and measured images / example given ; e.g. if microvillus measurement is in mm convert, microvillus measured length to μm / actual length to mm R if extra detail given is incorrect e.g. <u>divide</u> by 1000 for mm to μm divide, microvillus / image, length by, actual length / AW / $1(\mu\text{m})$; A idea that value for, microvillus / image, length is the magnification	2
1(c)(i)	any two from: (movement of substances) against concentration gradient / from low(er) to high(er) concentration ; (protein has) binding site(s) ; specific ; A description e.g. shape complementary to shape of substance can be in context of protein or binding site ref. to (binding causes protein), conformational change / change of shape ;	2

Answer for Question 18 (9700_s22_22_1)

Question	Answer	Marks
1(c)(ii)	<i>any two from:</i> 1 glucose is moving against a (concentration) gradient ; AW e.g. low to high 2 movement powered by inward movement of Na⁺ ; AW 3 Na⁺ movement (into cell from gut lumen) down an electrochemical gradient or down a (Na⁺), concentration / diffusion, gradient or by facilitated diffusion ; A diffusion if response includes <i>ref. to</i> the cotransport protein / cotransporter 4 AVP ; e.g. <i>idea that</i>, cotransport needed so that <u>all</u> glucose will be removed from gut lumen or a facilitated diffusion of glucose will only be to equilibrium / AW cotransporter has (specific) binding site for glucose I cotransporter has a complementary shape <i>idea that</i> there is no specific active uptake protein for glucose	2
1(c)(iii)	increases / larger / large, surface area (over which glucose can enter cell per unit time) ; A increases / higher / high, SA:V <i>idea of</i> (so) more, transport / carrier / cotransport, proteins A more cotransporters or more proteins, located in membrane / AW ; R pump proteins A <i>idea of</i> more space / places, where proteins can transport glucose	2

Answer for Question 18 (9700_s22_22_1)

Question	Answer		Marks
1(d)	any four from:		4
	suggestion max 3	explanation	
	1 to replace, old / dead / damaged / injured, cells or to, repair / replace, damaged tissue ; I repair cells I replace old tissues	6 idea of <u>function</u> in context of mp1 or 2 or 3 ; e.g. repair allows tissues to function specialisation / differentiation, allows, cells / tissue, to function genetically identical so cells can function as a tissue look for other approaches e.g. 'replace damaged cells that no longer function' is mp1 and mp6	
	2 cells are produced that can, differentiate / become specialised (into intestinal cells); I multipotent / AW R if, stated / strongly implied that, <u>all</u> cells produced by mitosis become specialised		
	3 produce cells that are genetically identical ; A clones A identical / same, DNA / genetic material / genetic information		
	4 growth ; R growth of cells	7 detail of function (intestines) ; e.g. absorption (of, glucose / nutrients) production of digestive enzymes pass absorbed, nutrients / AW, to blood I nutrition	
5 renew / replenish / restore number of / AW, stem cells ; I increase in stem cells	8 idea of development during, infancy / childhood ; 9 for, continued production / constant supply / AW, of intestinal cells or so that number of stem cells doesn't decrease ;		

Answer for Question 19 (9700_s22_23_5)

Question	Answer	Marks
5(a)	<i>any two from:</i> <i>ref. to can organise / order, enzymes / events, in pathway ;</i> consequence in terms of distance ; e.g. product of one reaction is close to next enzyme (where it acts as substrate) enzyme (more likely to be) closer to substrate distance between enzymes shorter I short distance / less distance to travel, unqualified (so) increases chance of successful collisions between substrate and enzymes ; increased rate of formation of final product or decrease time for ES complex to occur ; <i>idea that</i> products can pass to either side of the membrane ; all reactions, localised / occur in the same location (within the cell) ; AVP ; e.g. membrane provides a source of arachidonic acid I phospholipid	2
5(b)(i)	(similar shaped) curve to the right of main curve <u>and</u> reaches $V_{\max}$; A increasing to reach $V_{\max}$	1

Answer for Question 19 (9700_s22_23_5)

Question	Answer	Marks
5(b)(ii)	stays the same ; increases ;	2
5(c)(i)	the gene / PTGS2, is a sequence of nucleotides, that forms part of a DNA molecule / AW / on chromosome 1 ; A bases codes for (the production of) a, polypeptide / enzyme / COX-2 ; A protein I codes for an amino acid <i>max one if no example used</i>	2
5(c)(ii)	<i>any two from:</i> more, product / compounds, produced that stimulate mitosis ; increased, DNA replication / cell division / mitosis ; I <i>ref. to</i> cancer cells replicating <i>idea that</i> , may lead to / increases chance of / AW, (other) mutations ; mutations can result in oncogenes ; AVP ; e.g. <i>idea that</i> proof checking capacity impaired / increased chance of errors	2

Answer for Question 19 (9700_s22_23_5)

Question	Answer	Marks
5(d)	any three from: phospholipids may be, used in / added to, the (cell surface) membrane ; arachidonic acid, is unsaturated / polyunsaturated ; has, C=C / (carbon-carbon) double bonds ; <i>allow ecf if stated as saturated</i> unsaturated fatty acid tails, have kinks / not linear / AW ; A double bonds produce, kinks / AW increased distance between, phospholipids / other fatty acid tails ; A phospholipids cannot pack closely together less hydrophobic interactions between phospholipid (molecules) ;	3

Answer for Question 20 (9700_s22_23_2)

Question	Answer	Marks
2(a)	peptidoglycan / murein ; ribosomes ; (permanent / large) vacuole ;	3
2(b)	<i>any two from:</i> to prevent, lysis / bursting / AW or to prevent, (protoplast) shrinking / shrivelling / AW ; I damaged <i>ref. to</i> no net movement / AW, of water (occurs) ; (otherwise movement of water) by <u>osmosis</u> / down a water potential gradient / AW ;	2

Answer for Question 20 (9700_s22_23_2)

Question	Answer	Marks
2(c)(i)	<i>max 2 if stated as a protein or includes protein features</i> <i>any three from:</i> <i>cellulose molecule max 2</i> (β-glucose(s) joined by) glycosidic / glucosidic, bonds / linkages ; (monomers / β-glucose(s)) joined by (β) 1,4 (glycosidic) bonds ; R α-1,4 bonds R (β)1,4 <u>and</u> 1,6 bonds adjacent, monomers / β-glucoses, rotated through 180° ; AW straight / linear, chain ; <i>cellulose microfibril max 2</i> parallel, molecules / chains, of cellulose ; hydrogen bonds, between molecules / form cross bridges / between OH groups ; <i>idea that between adjacent cellulose molecules,</i> beginnings and ends in different places / overlap between starts and ends / staggered starts and ends ;	3
2(c)(ii)	<i>any one from:</i> hemicellulose ; pectin ; lignin ; AVP ; e.g. expansin	1
2(d)	spongy mesophyll / palisade mesophyll / palisade / mesophyll, (cell) ;	1

Answer for Question 21 (9700_w22_23_5)

Question	Answer	Marks
5(a)(i)	any two from: 1 idea of the cells have the, same receptor / specific receptor (for LL-37) ; 2 on cell (surface) membrane / inside cell ; 3 (shape of) receptor is complementary to (shape of), cathelicidin / signalling compound / ligand ; I antigen R active site	2
5(a)(ii)	any two from: 1 thin cells ; A (they are) squamous R 'made of squamous epithelial cells' I flat / flattened R 'they have thin (cell) walls' 2 smooth / AW, (luminal) surface ; 3 cells are wider in region of the nucleus ; A nucleus bulges from cell 4 ref to, endothelial pores / fenestrations / pores between cells / gaps between cells ;	2
5(b)(i)	(TTC to TAC) change from phe to tyr (at position 5) ; I 'tyr' unqualified	1

Answer for Question 21 (9700_w22_23_5)

Question	Answer	Marks
5(b)(ii)	<i>allow two marks for</i> new sequence is leu arg val ile ser ser gly asp leu ;; <i>or allow any two from:</i> I refs to frameshift 1 sequence after, first amino acid / first leu, is different ; R 'after position 2' A 'from position 2 onwards' 2 any example ; e.g. amino acid (at position 2) is arg 3 shortened polypeptide / early chain termination ;	2
5(b)(iii)	<i>any two from:</i> peptide is 3 amino acids in length / shortened polypeptide ; stop codon in position 4 ; (third) amino acid is <u>still</u>, gly(cine) / the same ;	2
5(c)	(genetic code) is the, same / similar, in all organisms AW or <i>idea that</i> each triplet codes for the same amino acid in all living organisms ;	1
5(d)	<i>any two from:</i> 1 (most) amino acids have more than one, triplet / codon ; 2 any correct example(s) from Table 5.2 ; <i>if award this then award mp1 as well</i> 3 genetic code is, degenerate / redundant ; R degenerative / degenerated 4 <i>idea that</i> 64 / 61, possible codons for 20 different amino acids ;	2

Answer for Question 22 (9700_m21_22_3)

Question	Answer	Marks
3(a)	<i>any one from:</i> stimulate / enhance / AW, macrophage response ; stimulate / enhance / AW, B-lymphocyte / B-cell / humoral, response ; A described part of humoral response e.g. increase antibody production stimulate / enhance / AW, T-killer / T-cytotoxic, response ; AVP ; e.g. suppresses immune response (during recovery) role in inflammation ref chemotaxis	1
3(b)(i)	<i>any two from:</i> <i>Leydig cell / not T-helper lymphocyte, because:</i> much / many / high proportion of, smooth endoplasmic reticulum ; (smooth endoplasmic reticulum present) that functions to synthesise, cholesterol / testosterone / steroid hormones / lipids ; no / little, rough endoplasmic reticulum ; rough endoplasmic reticulum is for polypeptide / protein synthesis ;	2
3(b)(ii)	transmission electron micrograph ; <i>plus one from:</i> cell ultrastructure can be seen / high resolution ; A detail e.g. membranes of mitochondrion cristae nuclear, envelope / membranes endoplasmic reticulum I rough / smooth (very) thin section / not surface contours / AW ; I ref. to magnification	2

Answer for Question 22 (9700_m21_22_3)

Question	Answer	Marks
3(c)(i)	<i>one correct mechanism stated plus one associated detail</i> (passive / simple) diffusion ; R facilitated diffusion / diffusion through (membrane) protein from high(er) to low(er) concentration / down a concentration gradient ; AVP ; e.g. via phospholipid bilayer / hydrophobic core / fatty acid tails / AW or endocytosis ; description / pinching in / vesicle formation ; AVP ; e.g. ATP / energy, required	2
3(c)(ii)	<i>any two from</i> hydrophilic / water soluble / polar ; cannot cross, hydrophobic core (of phospholipid bilayer) / AW ; too large (to pass through gaps in fatty acid tails) ; no (specific), transport / carrier, proteins ;	2

Answer for Question 23 (9700_s21_21_6)

Question	Answer	Marks
6(a)	A rough endoplasmic reticulum ; E Golgi, body / apparatus / complex ;	2
6(b)	transport from, (R)ER / ribosomes, to Golgi ; A from A to E A transport from Golgi to, cell surface membrane / phagosome A separate, acid hydrolases / enzymes, from, rest of cell / AW	1
6(c)	phagocytosis / endocytosis ;	1
6(d)	<i>any three from</i> 1 break down / digest / destroy, bacteria / pathogen(s) ; 2 break down / digest / destroy, (worn out / defective / AW), organelles / named organelle (in animal cell) ; A autophagy 3 catalyse / speed up, <u>hydrolysis</u> ; 4 any two named substrates ; e.g. (any named) polysaccharides / proteins / (phospho)lipids / (named) nucleic acids 5 <i>idea that</i> recycle / reuse, biological molecules within cell ; 6 (macrophage / phagocyte) cut up to present antigen ;	3
6(e)	moves / pump(s), hydrogen ions / protons, into the lysosome against concentration gradient ; active transport / uses ATP / energy from respiration / ref to conformational change of carrier ; R if a ref to facilitated diffusion	2

Answer for Question 24 (9700_s21_21_3)

Question	Answer	Marks
3(a)	<i>any three from</i> 1 <i>differences in height show that</i> concentrations of sucrose, 0, 0.4 and 0.8 (mol dm⁻³) <i>or</i> ≤ / less than, 0.8 / 0.9, water moves out of Visking tubing ; A one of 0, 0.4 or 0.8 R sucrose moving 2 concentrations of sucrose 1.2, 1.6, 2.0 (mol dm⁻³) <i>or</i> ≥ / more than, 0.9 / 1.2, water moves into Visking tubing ; A one of 1.2, 1.6 or 2.0 R sucrose moving 3 <i>ref. to <u>net</u> water movement ;</i> <i>if water enters Visking tubing – A ora for water leaving</i> 4 external solution has <u>higher</u> water potential (than contents of Visking tubing) ; A high water potential to low water potential 5 water moves, <u>down, water potential / Ψ, gradient</u> ;	3

Answer for Question 24 (9700_s21_21_3)

Question	Answer	Marks
3(b)	<i>mark whole question to a max of four marks</i> <i>descriptions</i> 1 at concentrations, less than / $\leq$, 0.04 mol dm^{-3} all cells, burst / AW ; 2 at concentrations between 0.04 and 0.14 mol dm^{-3} decreasing percentage of cells burst / AW ; A use of percentages 3 at concentrations, greater than / $\geq$, 0.14 mol dm^{-3} no cells, burst / AW ; <i>explanations to max 3</i> 4 in low concentrations / ≤ 0.04, of sodium chloride water moves into cells down water potential gradient / from high Ψ to low Ψ ; 5 cells increase in, volume / size / internal pressure ; 6 <i>either</i> <u>cell membranes</u> are not strong enough to withstand increase in volume / pressure or red blood cells burst because they have no cell wall ; 7 between 0.04 and $0.14 \text{ (mol dm}^{-3})$ water potential gradient into cells, decreases / becomes less steep / AW ; 8 above $0.14 \text{ (mol dm}^{-3})$ / in high concentrations, water potential inside cells is the same or higher than the sodium chloride solution ; 9 at high concentration / ≥ 0.14, water leaves cells / cells shrink / cells shrivel / cells show crenation ;	4

Answer for Question 25 (9700_s21_22_3)

Question	Answer	Marks																											
3(a)(i)	<i>accept from either column for mark and assume blood if not stated any three from</i> <table> <tr> <th>blood</th><th>tissue fluid</th><th></th></tr> <tr> <td>has red blood cells</td><td>has no red blood cells</td><td>;</td></tr> <tr> <td>more, white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or fewer macrophages</td><td>fewer white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or more macrophages</td><td>;</td></tr> <tr> <td>has platelets</td><td>has no platelets</td><td>;</td></tr> <tr> <td>has, more protein / large proteins or has, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>these are large proteins</i></td><td>has, fewer / no large, proteins or has no, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>only allow <u>fewer</u> plasma proteins if clear the proteins present are small enough to leave blood</i></td><td>;</td></tr> <tr> <td>higher, concentration / AW, oxygen A more oxygenated</td><td>lower, concentration / AW, oxygen A less oxygenated</td><td>;</td></tr> <tr> <td>higher, concentration / AW, glucose / amino acids / fatty acids</td><td>lower, concentration / AW, glucose / amino acids / fatty acids</td><td>;</td></tr> <tr> <td>lower, concentration / AW, carbon dioxide A urea, in liver / muscles I waste</td><td>higher, concentration / AW, carbon dioxide A urea, in liver / muscles I waste</td><td>;</td></tr> <tr> <td>higher pressure</td><td>lower pressure</td><td>;</td></tr> </table>	blood	tissue fluid		has red blood cells	has no red blood cells	;	more, white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or fewer macrophages	fewer white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or more macrophages	;	has platelets	has no platelets	;	has, more protein / large proteins or has, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>these are large proteins</i>	has, fewer / no large, proteins or has no, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>only allow <u>fewer</u> plasma proteins if clear the proteins present are small enough to leave blood</i>	;	higher, concentration / AW, oxygen A more oxygenated	lower, concentration / AW, oxygen A less oxygenated	;	higher, concentration / AW, glucose / amino acids / fatty acids	lower, concentration / AW, glucose / amino acids / fatty acids	;	lower, concentration / AW, carbon dioxide A urea, in liver / muscles I waste	higher, concentration / AW, carbon dioxide A urea, in liver / muscles I waste	;	higher pressure	lower pressure	;	3
blood	tissue fluid																												
has red blood cells	has no red blood cells	;																											
more, white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or fewer macrophages	fewer white blood cells / leucocytes / named e.g. neutrophils, lymphocytes, monocytes or more macrophages	;																											
has platelets	has no platelets	;																											
has, more protein / large proteins or has, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>these are large proteins</i>	has, fewer / no large, proteins or has no, plasma proteins / named example e.g. albumin / fibrinogen / globulin <i>only allow <u>fewer</u> plasma proteins if clear the proteins present are small enough to leave blood</i>	;																											
higher, concentration / AW, oxygen A more oxygenated	lower, concentration / AW, oxygen A less oxygenated	;																											
higher, concentration / AW, glucose / amino acids / fatty acids	lower, concentration / AW, glucose / amino acids / fatty acids	;																											
lower, concentration / AW, carbon dioxide A urea, in liver / muscles I waste	higher, concentration / AW, carbon dioxide A urea, in liver / muscles I waste	;																											
higher pressure	lower pressure	;																											
3(a)(ii)	lymph ; A lymphatic fluid	1																											

Answer for Question 25 (9700_s21_22_3)

Question	Answer	Marks
3(b)	<i>any two from:</i> 1 can cross / AW, hydrophobic core (of bilayer) / phospholipid bilayer or can pass through gaps between, fatty acid tails / phospholipids ; 2 is, hydrophobic / lipid-soluble / non-polar / not ionic / not charged or not, hydrophilic / water-soluble / polar / ionic / charged ; 3 small size ;	2
3(c)	Reject if hormone S or receptor R described as an antigen or enzyme complementary (shape) to / only fits into / specificity for (binding to), R / receptor ;	1
3(d)(i)	nuclear pore ; A nuclear pores	1
3(d)(ii)	B = transcription ; C = translation ;	2
3(d)(iii)	(80S) ribosome ; I 70S	1

Answer for Question 25 (9700_s21_22_3)

Question	Answer	Marks
3(e)	<i>any four from</i> 1 (formation of), secondary / 2° / second level, structure with, alpha-helix / α-helix / beta-pleated sheet(s) / β-pleated sheet(s) ; A β-conformation for β-pleated sheet I incorrect detail of bonds 2 folding / coiling, to form tertiary / 3° / third level, structure ; A <i>ref. to</i> 3D structure as alternative to, folding / coiling A secondary structure, folds / coils, to form tertiary structure R alpha helix / beta-pleated sheet, coils / folds 3 <i>two of</i> hydrogen bonds / ionic or electrostatic bonds / disulfide bonds or bridges / hydrophobic interactions ; I peptide bonds <i>as part of a list that contains two correct bond types</i> <i>these must be in context of tertiary structure</i> 4 (formation of), quaternary / 4° / fourth level structure ; A description e.g. polypeptides held together by, interactions / hydrogen bonds / ionic bonds / disulfide bonds R if peptide bonds included 5 (globular protein) has hydrophilic, amino acids / R-groups / side chains, to, outside / AW ; ora hydrophobic, amino acids / R-groups / side chains, towards centre / AW 6 example of other post-translational modification ; e.g. removal, methionine / met addition sugar group / glycosylation addition phosphate group / phosphorylation addition prosthetic group	4

Answer for Question 26 (9700_s21_22_5)

Question	Answer	Marks
5(b)(i)	<i>any one from</i> (only) polypeptides / proteins, synthesised at ribosomes ; carbohydrates / polysaccharides, not synthesised at ribosomes ; enzymes, for synthesis / required, not located at ribosomes ;	1
5(b)(ii)	exocytosis ;	1

Answer for Question 26 (9700_s21_22_5)

Question	Answer	Marks
5(c)	<i>accept substrate for cellulose and enzyme for cellulase</i> <i>allow use of extracted data to support a response to confirm awarding a mark</i> 1 correct description ; <i>overall trend or more detailed break down</i> e.g. as, cellulose / substrate, concentration increases, rate of reaction increases or as, cellulose / substrate, concentration increases, steep increase in rate of reaction then, less steep increase / (begins to) plateau I 'rate of reaction is fast and then slows down' <i>needs ref. to rate of reaction, describing 'gradient of curve' is not enough</i> <i>plus any two from</i> 2 increasing cellulose concentration increases number of, collisions between enzyme and substrate / enzyme-substrate complexes / ESCs ; A collisions between active site and substrate A <i>idea of</i> increased chances of cellulose binding to active site 3 at low cellulose concentrations, (many) active sites, available / not all used / not saturated ; 4 at higher cellulose concentrations, active sites becoming saturated / most active sites occupied / most active sites not available / AW ; A active sites are, saturated / occupied 5 named limiting factor(s), qualified ; e.g. at low(er) cellulose concentrations, cellulose concentration limiting / enzyme concentration not limiting A idea of, not enough cellulose / enzyme in excess as cellulose concentration increases, change from cellulose concentration limiting to enzyme concentration as limiting factor at higher cellulose concentrations, enzyme concentration limiting / cellulose concentration not limiting A idea of, cellulose in excess / not enough enzyme / enzyme working at its fastest rate / active sites not emptying quickly enough for substrate available	3

Answer for Question 26 (9700_s21_22_5)

Question	Answer	Marks
5(d)(i)	<i>mark to max 2 if microorganisms are considered to be enzyme inhibitors</i> <i>lower K_m for pectinase, any two from ultrasound</i> increases affinity of enzyme for substrate ; makes shape of active site more complementary ; makes (position of) active site more accessible (to substrate) ; A makes it easier for substrate to enter (active site) breaks up pectin, aggregates / AW, to expose more substrate for binding ; <i>higher V_{max} for xylanase, any two from ultrasound</i> increases rate of, collision between enzyme and substrate / more enzyme-substrate complexes per unit time ; I more ESC form <i>needs idea of increased rate</i> increases rate of catalysis after binding ; may change substrate for easier hydrolysis ; may lower, more than normal, activation energy required for reaction ; A described, e.g. increased ability to, break / form, bonds	3
5(d)(ii)	yes (as all have) increased, catalytic efficiency / productivity / V_{max}/K_m ; A manipulated data for increased catalytic efficiency <i>any two from</i> pectin 24.5 / 25% cellulase 17.25 / 17% xylanase 16.8 / 17%	1